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On all editorial matters, please contact Todd J. Barkman, 3437 Wood Hall, Department of Biological Sciences, Western Michigan University, Kalamazoo, MI 49008; 269. 387. 2776 (Phone), 269. 387. 5609 (FAX); todd.barkman@wmich.edu. All articles dealing with botany in the Great Lakes region may be sent to the Editor at the above address. In preparing manuscripts, authors are requested to follow the "Instructions for Authors" on the inside back cover.

For all inquiries about back issues and institutional subscriptions please contact Caroline Barkman, The Michigan Botanist Business Office, 919 Dobbin Dr., Kalamazoo, MI 49006; 269. 544. 0034; cbarkman9147@mail.kvcc.edu

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THE VASCULAR FLORA OF SEBERT PROPERTY, LAPORTE COUNTY, INDIANA

Scott Namestnik
JFNew
708 Roosevelt Road
Walkerton, Indiana 46574
snamestnik@jfnew.com

Keith Board
616 South Washington Street
Bremen, Indiana 46506
botanistkboard@gmail.com

ABSTRACT

Sebert Property is comprised of an approximately 40-acre matrix of hummocky wet to mesic flatwoods, dry sandy upland flats with seasonally inundated depressions, mesophytic forests and a buttonbush pond. A remarkable assemblage of 362 taxa of native vascular plants occurs here. Twenty (20) species are listed as endangered, threatened, rare (ETR) or extirpated in Indiana; additional taxa are uncommon in the Chicago Region and Indiana and 13 species are presented as new records for LaPorte County.

Keywords: Vascular Flora, Flatwoods, LaPorte County, Sebert Property

INTRODUCTION

Sebert Property is a 39.2-ac (15.8-ha) parcel that was donated to the LaPorte County Parks Foundation on 1 September 2000 by the late Wilmer and Rose Sebert, becoming the fifth county park in LaPorte County. No development has occurred at the site since that time. The property consists of swamp forest, early successional forest, mesophytic forest, upland forest, buttonbush swamp, sand barrens, seasonal pond, open water/mudflat, abandoned access road and roadside/roadside ditch communities. Portions of the property have been subjected to anthropogenic disturbances in the past, including excavation, likely for sand mining, and planting of pine trees; other portions are intact natural communities. A large percentage of the site consists of a community classified as boreal flatwoods by the Indiana Department of Natural Resources and The Nature Conservancy; Jacquart et al. (2002) describe the boreal flatwoods community as being dominated by *Quercus palustris*, *Acer rubrum* and *Ulmus americana*, with characteristic species including *Betula papyrifera* and *Ilex verticillata*.

We performed a thorough inventory of the vascular flora of Sebert Property in 2007 and 2008 because there is a lack of published data on sites with boreal flatwoods and associated communities in northern Indiana. In addition, an earlier informal study showed that Sebert Property was comprised of a rich flora that includes endangered, threatened and rare (ETR) plant species, numerous plants of high conservation value and several plant species not previously known from LaPorte County.

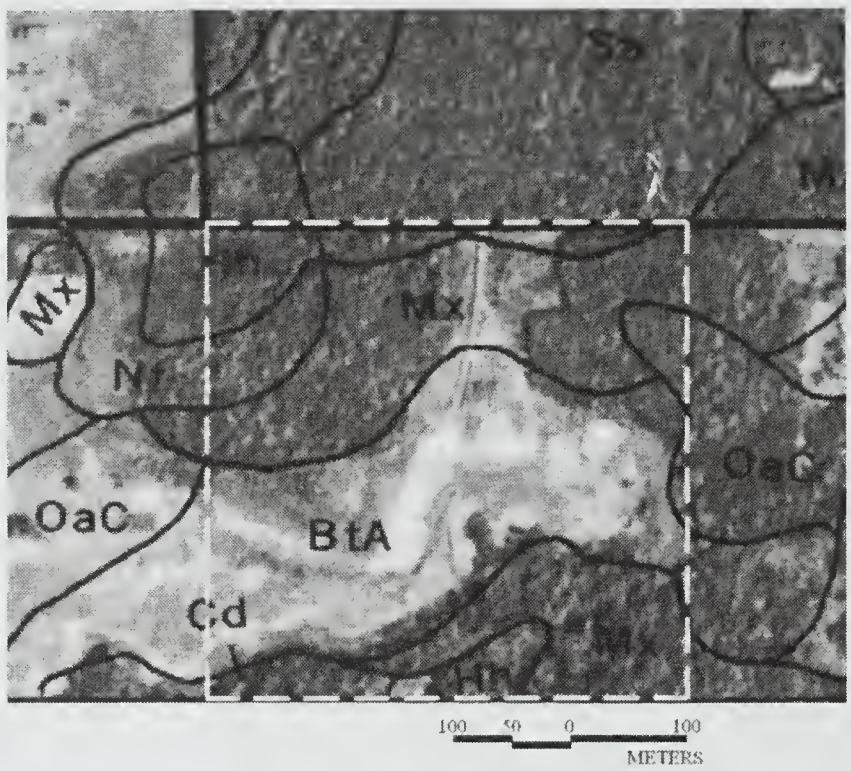

FIGURE 1. Soils map. BtA = Brems fine sand, 0–3% slopes; Cd = Cheektowaga fine sandy loam; Hh = Histosols and Aquolls; Mx = Morocco loamy fine sand; Nf = Newton loamy fine sand; OaC = Oakville fine sand, 4–12% slopes; Sa = Saugatuck-Pipestone complex.

Location

Sebert Property is located approximately 6 mi northeast of Michigan City, Indiana, on the south side of County Road 925 North, 0.6 mi west of County Road 300 West, directly south of Wintergreen Woods Nature Preserve in northern LaPorte County. The property is 1.3 mi south of the Michigan state line in Springfield Township, in the southeast ¼ of the southwest ¼ of Section 16, Township 38 North, Range 3 West (44°44′N, 86°46′W).

Soils and Geology

The property is located in the Oakville-Morocco-Brems soil unit; seven soil map units are present on the site (Figure 1) (USDA 1982). Moderately well drained to well drained fine sands (Brems fine sand; Oakville fine sand) are present in a low ridge that runs east-west across the site. Very poorly drained organic soils (Histosols and Aquolls) are present in a depression in the northwest corner of the site, and poorly to somewhat poorly drained soil (Saugatuck-Pipestone complex) exists along the north boundary of the site. The remainder of the property consists of fine sands and fine sandy loams that are somewhat to very poorly drained (Cheektowaga fine sandy loam; Morocco loamy fine sand; Newton loamy fine sand). Sand deposits at Sebert Property and in much of northwest Indiana are thought to be remnants of ancient beaches of glacial Lake Chicago, the precursor of Lake Michigan (Greenberg 2002).

Natural Communities

Located in the Northwestern Morainal Natural Region, Sebert Property is near the boundary between the Valparaiso Moraine Section, the Chicago Lake Plain Section and the Lake Michigan Border Section (Homoya et al. 1985). The

Valparaiso Moraine Section is characterized by forest to the east and prairie to the west, as well as fen, bog, lake, marsh, savanna, seep spring and swamp communities, on generally well drained calcareous silty clay loam soils; the Chicago Lake Plain Section is characterized by marsh, lake, sand savanna, sand prairie, forest and swamp communities on mostly acidic sandy soils; the Lake Michigan Border Section is characterized by beach, dune, forest, savanna and panne communities on sand and muck soils (Homoya et al. 1985). The plant communities and soil chemistry at Sebert Property are most similar to the communities that characterize the Chicago Lake Plain Section to the west, as marsh, swamp and forest communities are present on sandy and mostly acidic soils (USDA 1982). Of the swamp community behind the dunes of Lake Michigan, Swink & Wilhelm (1994) state that "this system is one of the richest and most complicated systems in our region . . . characterized by a complex hydrology and... interspersed by gentle rises, shallow depressions, and hummocks. . . ." Sebert Property fits this description quite well. In addition, several degraded communities including old-field, sand blowout and young successional forest are present. Historically, the central early successional forest, central sand barrens and west sand barrens are presumed to have been a sand ridge. This area has been cleared of vegetation and leveled within the past 40 years.

MATERIALS AND METHODS

Floristic Inventory

A meander survey following the methods of Goff et al. (1982) was conducted in 2005 by the authors with occasional assistance from others, resulting in a plant list of 292 taxa. For that study, collections were made for identification purposes but no attempt was made to collect voucher specimens for the entire flora. The resulting species list from 2005 was used as a guide for this more thorough study also conducted by meander survey in 2007 and 2008. The current study resulted in substantial additions to the list of known vascular plants at Sebert Property. Plant communities were generally mapped (Figure 2) as part of the study to document location of occurrence of collected specimens. With a few noted exceptions, a specimen of each taxon was collected and deposited at the herbarium of The Morton Arboretum, Lisle, Illinois (MOR). For a few conservative species that occurred in

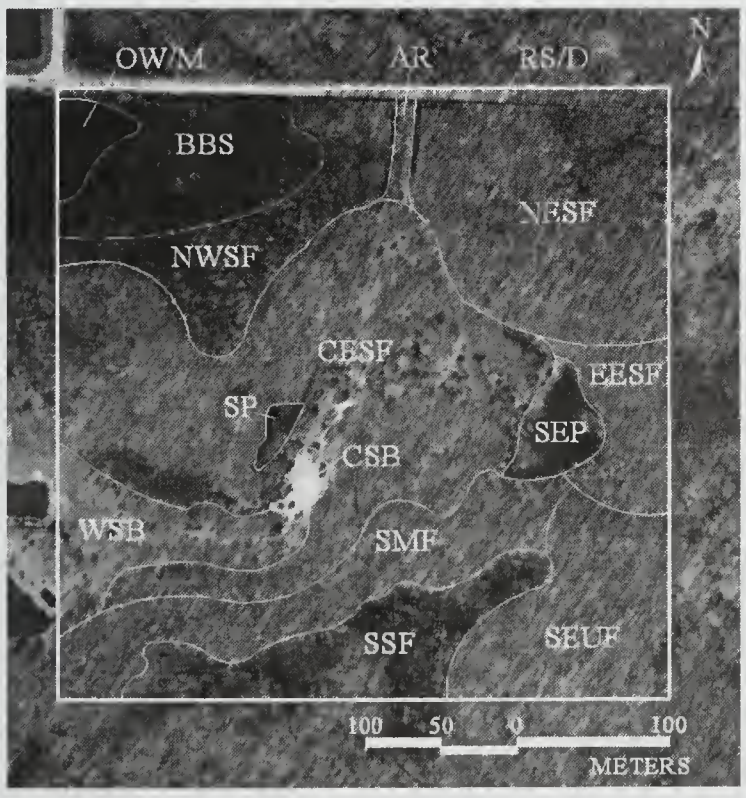

FIGURE 2. Plant communities at Sebert Property. AR = Abandoned road; BBS = Buttonbush swamp; CESF = Central early successional forest; CSB = Central sand barrens; EESF = East early successional forest; NESF = Northeast swamp forest; NWSF = Northwest swamp forest; OW/M = Open water/mudflat; RS/D = Roadside and ditch; SEP = Southeast pond; SP = Small pond; SMF = South mesophytic forest; SEUF = Southeast upland forest; SSF = South swamp forest; WSB = West sand barrens.

very small numbers, only photographic vouchers were submitted. The primary sources for plant identification were Gleason & Cronquist (1991) and Swink & Wilhelm (1994). Additional resources consulted for the identification of plant species included Deam (1940), Fernald (1950), Flora of North America Editorial Committee, eds. (1993+), Hitchcock (1950), Holmgren (1998), Mohlenbrock (2002), Steyermark (1963), Voss (1972, 1985, 1996) and Yatskievych (1999, 2006). Nomenclature in the species list follows The PLANTS Database (USDA, NRCS 2009).

Floristic Quality Assessment

Floristic Quality Assessment (FQA) was used to evaluate the natural area potential of the site and to allow for comparison with other sites where inventories have been conducted. Coefficient of conservatism values (C-values) for Indiana were obtained from Rothrock (2004). The methods outlined by Swink & Wilhelm (1994) and Rothrock (2004) for determining floristic quality were followed.

RESULTS

Floristic Inventory

A total of 434 vascular plant taxa representing 245 genera and 90 families were observed and identified to at least the species level (Appendix 1). Of these, 362 (83%) are native to the Chicago Region; seventy-two (17%) are non-native. These figures consider the following species, which are native in Indiana but thought to be non-native in the Chicago Region or intentionally introduced at the site, as non-native: *Andropogon virginicus*, *Pinus virginiana*, *Robinia pseudoacacia*, *Thuja occidentalis* and *Tridens flavus* var. *flavus*. Many of the non-native plants occur in disturbed ground on the edge of County Road 925 North along the northern site boundary.

Four additional taxa were observed but not identified to species: two species of *Platanthera*, one species of *Typha* and one species of *Vernonia*. Several individuals of one of the species of *Platanthera* (*SAN PH-6* [MOR]) were observed, but none produced flowers during the study. One individual each of the other species of *Platanthera* (*SAN PH-8* [MOR]), *Vernonia* (no collection) and *Typha* (no collection) were observed, but none of these produced flowers during the study. The *Typha* sp. was found along the right-of-way along County Road 925 North and was mowed prior to anthesis. These taxa were not included in the total species count or the Floristic Quality Assessment.

Pteridophytes were represented by 22 taxa (5%), gymnosperms were represented by six taxa (1%) and angiosperms were represented by 406 taxa (94%). Poaceae was the most common family, with 51 taxa (12%) identified. Asteraceae and Cyperaceae were also well represented, with 44 taxa (10%) each. Rosaceae was the fourth most common family, with 25 taxa (6%) collected. *Carex* was the most well represented genus, with 35 taxa (8%) documented.

Swink & Wilhelm (1994), in their discussion of *Woodwardia areolata* (L.) T. Moore, note that "the dune region is a virtual repository of both boreal and coastal-plain disjuncts and relicts." There are numerous plants at Sebert Property that are more commonly encountered outside of the Chicago Region, some of which may be remnants from a time when the climate was cooler, or from when coastal areas were further inland. The term "boreal" is certainly applied differently at every latitude. In Indiana and the Chicago region, this description is used

TABLE 1. Boreal relicts (Swink & Wilhelm 1994) at Sebert Property.

Betula papyrifera Marsh.
Betula populifolia Marsh.
Coptis trifolia (L.) Salisb.
Juniperus communis L.
Maianthemum canadense Desf.
Panax trifolius L.
Pinus strobus L.
Pyrola elliptica Nutt.
Thuja occidentalis L. Planted at site
Trientalis borealis Raf.

TABLE 2. Coastal plain disjuncts (Swink & Wilhelm 1994) at Sebert Property.

Bartonia virginica (L.) Britton, Sterns & Poggenb.
Bidens discoidea (Torr. & A. Gray) Britton
Carex albolutescens Schwein.
Carex longii Mack.
Carex seorsa Howe
Juncus scirpoides Lam.
Linum striatum Walter
Lycopodiella inundata (L.) Holub
Polygonum careyi Olney
Rhexia virginica L.
Triadenum virginicum (L.) Raf.
Woodwardia virginica (L.) Sm.

for northern species with limited distribution near Lake Michigan. Similarly, coastal plain disjuncts, as referred to in Indiana and the Chicago region, are those plants that are much more common on the coastal plain and outer piedmont of the Mid-Atlantic states, but that are much more restricted in distribution in the Great Lakes states. Using categorizations from Swink & Wilhelm (1994), nine naturally occurring boreal relicts (Table 1) and 12 naturally occurring coastal plain disjuncts (Table 2) were observed. Examples of boreal relicts are shown in Figures 3–7 and a coastal plain disjunct is shown in Figure 8. Many other species characteristic of the boreal flatwoods community were documented.

Floristic Quality

Based on the taxa identified, Sebert Property has a mean C-value of 3.7 (native mean C-value of 4.4) and a floristic quality index (FQI) of 76.0 (native FQI of 83.3). Sites with mean C-values of 4.5 or higher or FQI values of 45 are usually representative of intact natural plant communities (Swink & Wilhelm 1994). As shown in Figure 9, the C-value distribution of native species generally follows a bell curve, with the greatest percentage of native species having a C-value of 4 (63 species, 17%). Species with a C-value of 4 occasionally thrive in communities with anthropogenic disturbance (Rothrock & Homoya 2005). Despite past disturbance at Sebert Property, 31 species (9%) have a C-value of 9 or 10 (Table 3). These plants are thought to be restricted to remnant landscapes that appear to have suffered very little post-settlement trauma (Rothrock 2004).

FIGURE 3. Boreal relict *Coptis trifolia* (L.) Salisb. in swamp forest, April 25, 2009. Photograph by Keith Board.

FIGURE 4. Boreal relict *Maianthemum canadense* Desf. in swamp forest, May 26, 2008. Photograph by Keith Board.

FIGURE 5. Boreal relict *Panax trifolius* L. with *Viola rostrata* Pursh in mesophytic forest, May 17, 2008. Photograph by Keith Board.

FIGURE 6. Boreal relict *Pyrola elliptica* Nutt. in swamp forest, June 28, 2008. Photograph by Keith Board.

FIGURE 7. Boreal relict *Trientalis borealis* Raf. in swamp forest, May 21, 2008. Photograph by Keith Board.

FIGURE 8. Coastal plain disjunct *Woodwardia virginica* (L.) Sm. in roadside ditch, July 16, 2009. Photograph by Keith Board.

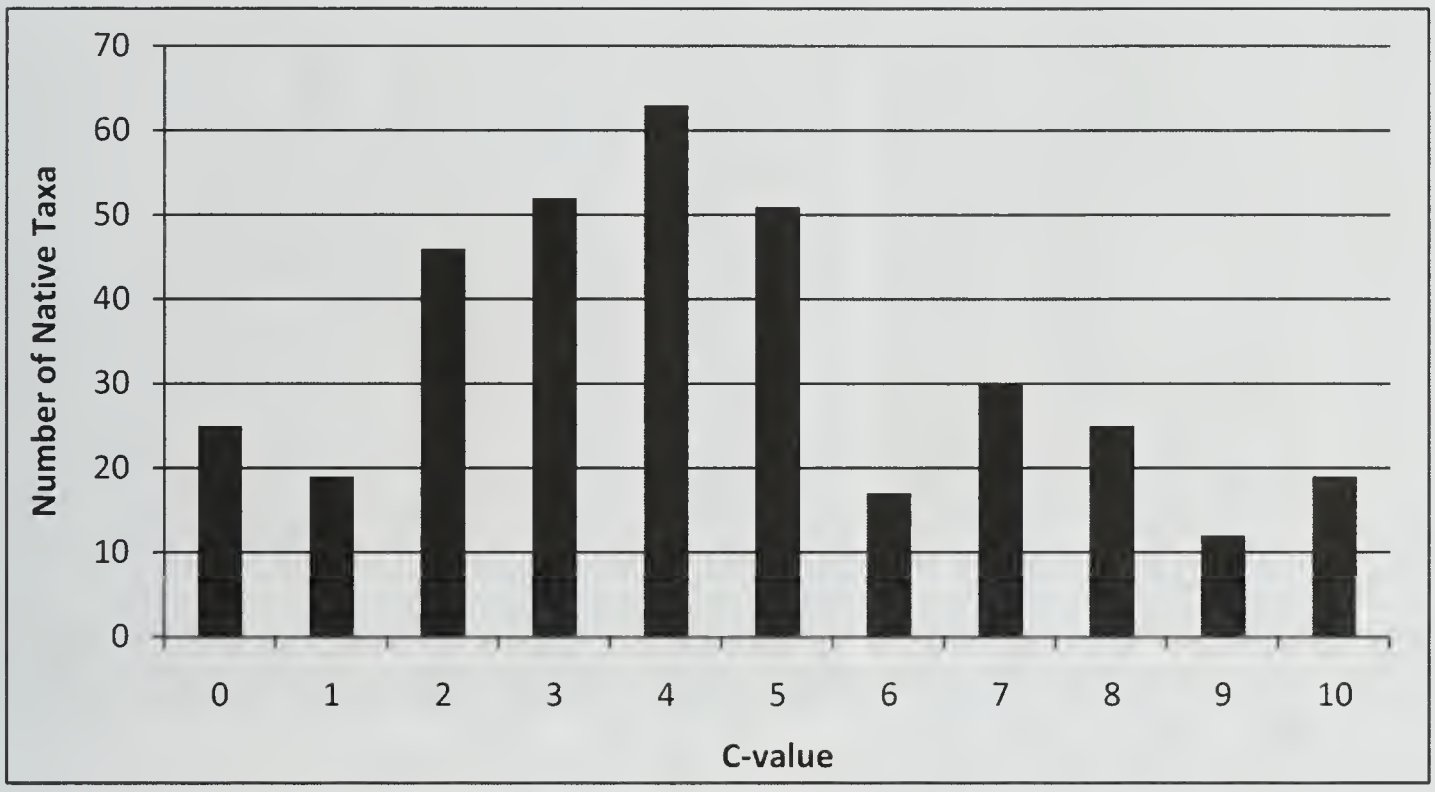

FIGURE 9. C-value distribution of native species at Sebert Property.

TABLE 3. Species with C-value of 9 or 10 (Rothrock 2004) at Sebert Property.

Betula populifolia Marsh.	10
Brachyelytrum aristosum (Michx.) Trel.	10
Carex arctata Boott ex Hook.	10
Carex brunnescens (Pers.) Poir.	10
Carex debilis Michx. var. *rudgei* L.H. Bailey	10
Carex folliculata L.	10
Carex seorsa Howe	10
Coptis trifolia (L.) Salisb.	10
Dryopteris intermedia (Muhl. ex Willd.) A. Gray	10
Juniperus communis L.	10
Lonicera canadensis Bartram ex Marsh.	10
Lycopodium tristachyum Pursh	10
Polygonum careyi Olney	10
Sparganium americanum Nutt.	10
Torreyochloa pallida (Torr.) Church var. *pallida*	10
Triadenum virginicum (L.) Raf.	10
Trientalis borealis Raf.	10
Viola macloskeyi Lloyd ssp. *pallens* (Banks ex Ging) M.S. Baker	10
Woodwardia virginica (L.) Sm.	10
Alnus incana (L.) Moench ssp. *rugosa* (Du Roi) R.T. Clausen	9
Carex albolutescens Schwein.	9
Carex tonsa (Fernald) E.P. Bicknell var. *rugosperma* (Mack.) Crins	9
Carex tonsa (Fernald) E.P. Bicknell var. *tonsa*	9
Juncus scirpoides Lam.	9
Osmunda cinnamomea L.	9
Panax trifolius L.	9
Platanthera clavellata (Michx.) Luer	9
Salix myricoides Muhl. var. *myricoides*	9
Vaccinium corymbosum L.	9
Veronica scutellata L.	9
Viola lanceolata L.	9

TABLE 4. Indiana endangered, threatened, rare and watch list species (Indiana Department of Natural Resources 2010) at Sebert Property.

Extirpated

Lonicera canadensis Bartram ex Marsh.

Endangered

Betula populifolia Marsh.
Brachyelytrum aristosum (Michx.) Trel.[2]
Carex arctata Boott ex Hook.
Carex brunnescens (Pers.) Poir.
Lycopodiella inundata (L.) Holub
Rubus enslenii Tratt.
Thuja occidentalis L.[1]

Threatened

Geranium robertianum L.
Juncus scirpoides Lam.
Polygonum careyi Olney

Rare

Carex debilis Michx. var. *rudgei* L.H. Bailey
Carex folliculata L.
Carex seorsa Howe
Juniperus communis L.
Lycopodium obscurum L.
Lycopodium tristachyum Pursh
Pinus strobus L.
Poa alsodes A. Gray
Prunus pensylvanica L. f

Watch List

Alnus incana (L.) Moench ssp. *rugosa* (Du Roi) R.T. Clausen
Betula papyrifera Marsh.
Chimaphila maculata (L.) Pursh
Coptis trifolia (L.) Salisb.
Huperzia lucidula (Michx.) Trevis.
Linum striatum Walter
Lycopodium clavatum L.
Panax trifolius L.
Pinus virginiana Mill.[1]
Platanthera clavellata (Michx.) Luer
Platanthera lacera (Michx.) G. Don
Pyrola elliptica Nutt.
Spiranthes ovalis Lindl. var. *erostellata* Catling
Viola blanda Willd. var. *palutriformis* A. Gray
Viola pubescens Aiton

[1] Presumed introduced at site
[2] Recently documented in Indiana; populations being tracked by IDNR

Plant Species of Concern

Endangered, threatened and rare plants are tracked by the Indiana Department of Natural Resources (IDNR). Plants on the endangered list have one to five occurrences statewide; those with six to 10 known occurrences are listed as threatened; rare species have 11 to 20 known occurrences. A fourth category of concern is watch list. Watch list species were previously on the ETR list but have since been removed, often because they are represented by greater than 20 occurrences. If a plant is removed from the ETR list, it remains on the watch list perpetually, unless there is reason to move it back to ETR. Watch list species are not actively tracked by the IDNR. (M.A. Homoya, pers. comm., February 2008)

Table 4 displays a list of plants observed at Sebert Property that are considered endangered, threatened or rare in Indiana, or that are on the watch list (IDNR 2010). Seven species listed as endangered, three listed as threatened and nine listed as rare were observed on the site. Examples of some of these species can be seen in Figures 10–12. One species previously thought to be extirpated from Indiana, *Lonicera canadensis* (*SAN 152* [MOR]), was observed at the site. Two orchid species that never produced flowers during the study were observed;

FIGURE 10. Indiana watch list species *Huperzia lucidula* (Michx.) Trevis. in swamp forest, October 26, 2008. Photograph by Keith Board.

FIGURE 11. Indiana watch list species *Lycopodium clavatum* L. in early successional forest, October 26, 2008. Photograph by Keith Board.

FIGURE 12. Indiana rare species *Lycopodium tristachyum* Pursh in early successional forest, October 26, 2008. Photograph by Keith Board.

TABLE 5. New LaPorte County records (Swink & Wilhelm 1994; The vPlants Project 2009) from Sebert Property.

Brachyelytrum aristosum (Michx.) Trel.
Carex brunnescens (Pers.) Poir.
Carex longii Mack.
Cerastium pumilum W. Curtis
Corallorhiza odontorhiza (Willd.) Poir.
Lonicera canadensis Bartram ex Marsh.
Lycopus rubellus Moench.
Malus ioensis (Alph. Wood) Britton
Pinus virginiana Mill.
Populus × *canescens* (Aiton) Sm. (pro sp.) [*alba* × *tremula*]
Ranunculus flabellaris Raf.
Salix petiolaris Sm.
Solidago canadensis L.

these may be *Platanthera psycodes* (listed as rare in Indiana; *SAN PH-6* [MOR]) and *P. flava* var. *herbiola* (listed as watch list in Indiana; *SAN PH-8* [MOR]).

New County Records

Table 5 displays a list of 13 plants not previously known from LaPorte County, Indiana (Swink & Wilhelm 1994; The vPlants Project 2009). Of these records, *Cerastium pumilum* (*Board 512* [MOR]), *Pinus virginiana* (*Board 388* [MOR]; *SAN 47* [MOR]; *SAN 48* [MOR]) and *Populus* × *canescens* (*Board 422* [MOR]) are introduced; the remaining 10 are native.

FIGURE 13. South swamp forest, April 5, 2008. Photograph by Scott Namestnik.

FIGURE 14. South swamp forest, May 31, 2008. Photograph by Scott Namestnik.

DISCUSSION

Sebert Property consists of a mosaic of plant communities that are collectively considered boreal flatwoods (Figure 2). The most common tree species based on visual observations include *Acer rubrum*, *Betula papyrifera*, *Fagus grandifolia*, *Liriodendron tulipifera*, *Nyssa sylvatica*, *Quercus alba*, *Q. bicolor*, *Q. palustris*, *Q. rubra*, *Salix nigra*, *Sassafras albidum* and *Ulmus americana*. A mix of swamp forest (Figures 13 and 14), mesophytic forest (Figure 15) and upland forest (Figure 16) make up the north and south thirds of the property. These are the communities least disturbed by anthropogenic influences. Tree tip-ups are common throughout the swamp forests (Figure 17), creating functional microhabitats and amphibian breeding pools. Shrub swamp dominated by *Cephalanthus occidentalis* occupies the northwest corner of the site (Figure 18). Within this buttonbush swamp, a small submerged/emergent wetland that is seasonally to permanently inundated is present in the extreme northwest corner. A somewhat level area that was once a higher sand ridge runs approximately east-west through the middle of the property. As shown on the base map aerial photograph for the LaPorte County Soil Survey, ca. 1970 (Figure 1), this ridge was cleared of vegetation for farming, pasture or potential use as a sand borrow area. These sand flats now exist mostly as disturbed communities including young successional forest (Figure 19) and sand barrens (Figure 20), including a sand blowout area (Figure 21). Conifers in this area that presumably were planted include *Pinus sylvestris*, *P. virginiana*, and *Thuja occidentalis*. Two seasonal ponds that

FIGURE 15. South mesophytic forest, April 5, 2008. Photograph by Scott Namestnik.

FIGURE 16. Southeast upland forest, April 5, 2008. Photograph by Scott Namestnik.

FIGURE 17. Tree tip-up in northeast swamp forest, April 5, 2008. Photograph by Scott Namestnik.

FIGURE 18. Buttonbush swamp, May 31, 2008. Photograph by Scott Namestnik.

FIGURE 19. Central early successional forest, November 2, 2008. Photograph by Keith Board.

can be characterized as acid sand flat openings are present here (Figure 22). Many species in these flats are typically found in artificial excavations where sand has been removed down to the water table (Swink & Wilhelm 1994); it is likely that sand was removed from these areas in the past. Two excavated ditches are present on either side of an abandoned access road at the north end of the site (Figure 23). These ditches lead to the roadside ditch along County Road 925 North (Figure 24); it appears that an attempt was made at some point to drain portions of the property.

Comparisons of floristic inventories should be viewed with circumspection, as many variables, including different surveyors, different methods of collecting and identifying species and different levels of survey intensity can all play a part in the number of species observed. With these things in mind, comparing the quality of natural areas in terms of number of species, mean C-values and FQI can generally show where a site ranks in terms of natural area floristic quality. With 434 vascular plants in 40 acres, Sebert Property has a level of species richness greater than that at other sites of equal or greater size for which vascular plant inventories have been recorded in Indiana (Appendix 2) (Rothrock & Homoya 2005; Angstmann et al. 2006; Ruch et al. 2008; Ruch et al. 2008). Of the sites shown in Appendix 2, Barker Woods Nature Preserve is most like Sebert Property in terms of plant communities and species composition. Barker Woods has a higher mean C-value than Sebert Property, but Sebert Property has more than twice the number of species, including natives, resulting in much higher FQI values.

FIGURE 20. West sand barrens, April 5, 2008. Photograph by Scott Namestnik.

The numerous plant communities at Sebert Property support a diverse mix of vascular plants, including several ETR species and species with affinities to more boreal or coastal plain regions. It is noteworthy that 83% of the 434 vascular plants documented in the flora of Sebert Property are considered native, and that 13 new county records were discovered. In addition, 31 of the recorded species have C-values of 9 or 10, indicating that portions of the site still harbor pre-settlement natural area quality despite moderate anthropogenic disturbance in the past.

Sebert Property is an important tract of land for conservation of at-risk plant species in Indiana. The Lake Michigan-influenced climate, the acidic soils and the location of the site at the northern extent of Indiana allow species that are more common further north to survive here at the southern extent of their geographic ranges. Many of these boreal relicts are considered species of concern in Indiana because they are not known from other parts of the state.

The presence of 10 native species not previously known from LaPorte County further illustrates the ecological significance of Sebert Property. The unique assemblage of plant communities, soil types, hydroperiod and disturbance provides appropriate conditions for species otherwise unknown from LaPorte County to survive at this location. This approximately 40-acre tract of land also provides habitat for *Lonicera canadensis*, a native shrub that was considered extirpated from Indiana prior to this study.

Future research at Sebert Property and in northern LaPorte County in general could be directed towards the genera *Dichanthelium* at drier sites and *Betula* in forests. A population of an unusual *Dichanthelium*, determined as *D. oligosanthes* (*SAN 474* [MOR]), was collected in early successional sand barrens at the site. The

FIGURE 21. Central sand barrens, April 5, 2008. Photograph by Scott Namestnik.

FIGURE 22. Southeast pond, October 25, 2008. Photograph by Keith Board.

FIGURE 23. Abandoned road, April 5, 2008. Photograph by Scott Namestnik.

FIGURE 24. Roadside and roadside ditch, May 31, 2008. Photograph by Scott Namestnik.

plants have long spreading papillose-based upper sheath hairs and purplish culms, and are intermediate between *D. oligosanthes* ssp. *oligosanthes* and *D. oligosanthes* ssp. *scribnerianum*. Though the plants have longer, narrower leaves characteristic of *D. oligosanthes* ssp. *oligosanthes*, they have shorter spikelets characteristic of *D. oligosanthes* ssp. *scribnerianum*. Another *Dichanthelium* of interest, tentatively determined as *D. clandestinum* × *depauperatum* (*Board 652* [MOR]), was discovered in early successional sand barrens near a sand blowout.

Trees of the genus *Betula* are frequent in northern LaPorte County, and both *B. papyrifera* and *B. populifolia* are encountered at Sebert Property. It would be important to determine whether the two are hybridizing, as trees with intermediate characteristics are observed frequently. It is also unclear whether local colonies of *B. populifolia* are naturally occurring or escaped from cultivation. Perhaps most importantly, many local reports of *B. populifolia* are misidentifications of *B. pendula* (European White Birch), which often grows in sandy woods in the dune area, and telling these two species apart can be "quite a trial" (Swink & Wilhelm 1994); this has important implications for management purposes.

This study provides a baseline to help future researchers understand the natural and anthropogenic changes occurring at Sebert Property and the surrounding area. Ideally, our study will promote further botanical studies as well as a casual appreciation of the local flora. In addition, it will provide useful data for the owner, LaPorte County Parks Foundation, as management and/or development decisions are considered. To preserve the natural character of the property, it will be increasingly important to monitor the spread of invasive species, which can quickly lead to the degradation of a natural area. This will be especially important along anthropogenically disturbed areas such as the road and trails through the site. Natural succession will also cause changes to the flora of the site. The plant communities present at Sebert Property will require some form of disturbance to be maintained in their present state. In swamp forest areas, windthrown trees naturally open the canopy and reset successional processes. In the acid sand flat openings, historic sand mining removed accumulations of organic material and exposed an ancient seed bank; without disturbance these areas are expected to fill in over time, changing the composition of the acid sand flat openings flora. The successional forest and sand barren communities will also change with time if no management takes place. Future management decisions will determine how the flora of Sebert Property changes in the coming decades.

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APPENDICES

APPENDIX 1. Vascular flora of Sebert Property.

Board = Keith Board; SAN = Scott A. Namestnik; PH = photo documentation. Nomenclature follows The PLANTS Database (USDA, NRCS 2009); where family classifications differ from those of the Angiosperm Phylogeny Group (APG), APG classifications are included in brackets. C-values are from Floristic quality assessment in Indiana: The concept, use, and development of coefficients of conservatism (Rothrock 2004).

PTERIDOPHYTES			
ASPLENIACEAE (Spleenwort Family)			
Asplenium platyneuron (L.) Britton, Sterns & Poggenb.	Ebony Spleenwort	C=3	Board 596
BLECHNACEAE (Chainfern Family)			
Woodwardia virginica (L.) Sm.	Virginia Chainfern	C=10	Board 701
DENNSTAEDTIACEAE (Bracken Fern Family)			
Pteridium aquilinum (L.) Kuhn var. latiusculum (Desv.) Underw. ex A. Heller	Western Brackenfern	C=5	SAN 615
DRYOPTERIDACEAE (Wood Fern Family)			
Athyrium filix-femina (L.) Roth	Common Ladyfern	C=6	Board 632
Dryopteris intermedia (Muhl. ex Willd.) A. Gray	Intermediate Woodfern	C=10	Board 606
Dryopteris carthusiana (Vill.) H.P. Fuchs	Spinulose Woodfern	C=6	Board 586
Onoclea sensibilis L.	Sensitive Fern	C=4	Board 714
Polystichum acrostichoides (Michx.) Schott	Christmas Fern	C=5	Board 615
EQUISETACEAE (Horsetail Family)			
Equisetum arvense L.	Field Horsetail	C=1	Board 670
LYCOPODIACEAE (Club Moss Family)			
Huperzia lucidula (Michx.) Trevis.	Shining Clubmoss	C=5	SAN 11; SAN 66
Lycopodiella inundata (L.) Holub	Inundated Clubmoss	C=7	SAN PH-s.n.
Lycopodium clavatum L.	Running Clubmoss	C=4	SAN 6
Lycopodium digitatum Dill. ex A. Braun	Fan Clubmoss	C=2	SAN 4
Lycopodium obscurum L.	Rare Clubmoss	C=6	SAN 3
Lycopodium tristachyum Pursh	Deeproot Clubmoss	C=10	Board 389; Board 542; SAN 7
OPHIOGLOSSACEAE (Family)			
Botrychium dissectum Spreng.	Cutleaf Grapefern	C=3	SAN PH-3
Botrychium virginianum (L.) Sw.	Rattlesnake Fern	C=4	Board 507

OSMUNDACEAE (Royal Fern Family)			
Osmunda cinnamomea L.	Cinnamon Fern	C=9	Board 521
Osmunda claytoniana L.	Interrupted Fern	C=8	SAN 286
Osmunda regalis L. var. spectabilis (Willd.) A. Gray	Royal Fern	C=8	Board 543
THELYPTERIDACEAE (Marsh Fern Family)			
Thelypteris noveboracensis (L.) Nieuwl.	New York Fern	C=5	Board 642
Thelypteris palustris Schott var. pubescens (G. Lawson) Fernald	Eastern Marsh Fern	C=7	Board 685
GYMNOSPERMS			
CUPRESSACEAE (Cypress Family)			
Juniperus communis L.	Common Juniper	C=10	SAN 128
Juniperus virginiana L.	Eastern Redcedar	C=2	SAN 130
Thuja occidentalis L.	Arborvitae	**	SAN 108; SAN 127
PINACEAE (Pine Family)			
Pinus strobus L.	Eastern White Pine	C=5	SAN 92
Pinus sylvestris L.	Scots Pine	*	Board 702; SAN 37; SAN 46
Pinus virginiana Mill.	Virginia Pine	**	Board 388; SAN 47; SAN 48
ANGIOSPERMS			
ACERACEAE (Maple Family) [SAPINDACEAE]			
Acer rubrum L.	Red Maple	C=5	Board 504; SAN 105
ALISMATACEAE (Water Plantain Family)			
Alisma subcordatum Raf.	American Water Plantain	C=2	Board 677
ANACARDIACEAE (Cashew Family)			
Rhus copallinum L. var. latifolia Engl.	Winged Sumac	C=3	Board 659
Rhus typhina L.	Staghorn Sumac	C=2	SAN 302
Toxicodendron radicans (L). Kuntze ssp. radicans	Eastern Poison Ivy	C=1	SAN 453
APIACEAE (Carrot Family)			
Cicuta maculata L.	Spotted Water Hemlock	C=6	Board 669
Daucus carota L.	Queen Anne's Lace	*	Board 684; SAN 41
Osmorhiza claytonii (Michx.) C.B. Clarke	Clayton's Sweetroot	C=3	Board 519

Osmorhiza longistylis (Torr.) DC.	Longstyle Sweetroot	C=3	Board 520
Sanicula canadensis L.	Canadian Blacksnakeroot	C=2	Board 710; SAN 438
Sanicula odorata (Raf.) K.M. Pryer & L.R. Phillippe	Clustered Blacksnakeroot	C=2	SAN 418
Sium suave Walter	Hemlock Waterparsnip	C=5	SAN 526
APOCYNACEAE (Dogbane Family)			
Apocynum cannabinum L.	Indianhemp	C=2	SAN 531
AQUIFOLIACEAE (Holly Family)			
Ilex verticillata (L.) A. Gray	Common Winterberry	C=8	SAN 434
ARACEAE (Arum Family)			
Arisaema triphyllum (L.) Schott	Jack in the Pulpit	C=4	Board 487
ARALIACEAE (Ginseng Family)			
Aralia nudicaulis L.	Wild Sarsaparilla	C=7	SAN 416
Panax trifolius L.	Dwarf Ginseng	C=9	SAN 8; SAN 15
ASCLEPIADACEAE (Milkweed Family) [APOCYNACEAE]			
Asclepias incarnata L.	Swamp Milkweed	C=4	SAN 546
Asclepias syriaca L.	Common Milkweed	C=1	Board 717
Asclepias tuberosa L.	Butterfly Milkweed	C=4	Board 631
ASTERACEAE (Aster Family)			
Achillea millefolium L.	Common Yarrow	C=0	Board 593
Ageratina altissima (L.) King & H. Rob. var. altissima	White Snakeroot	C=2	Board 722
Ambrosia artemisiifolia L. var. elatior (L.) Descourtils	Annual Ragweed	C=0	SAN 570
Ambrosia trifida L.	Great Ragweed	C=0	SAN 579
Antennaria neglecta Greene	Field Pussytoes	C=3	Board 505
Antennaria plantaginifolia (L.) Richardson	Woman's Tobacco	C=3	Board 595
Arctium lappa L.	Greater Burdock	*	SAN 616
Bidens connata Muhl. ex Willd.	Purplestem Beggarticks	C=2	SAN 604; SAN 605
Bidens discoidea (Torr. & A. Gray) Britton	Small Beggarticks	C=5	SAN 603
Bidens frondosa L.	Devil's Beggartick	C=1	SAN 618
Bidens tripartita L.	Threelobe Beggarticks	C=2	SAN 632
Cichorium intybus L.	Chicory	*	Board 719
Conyza canadensis (L.) Cronquist var. canadensis	Canadian Horseweed	C=0	Board 687

Erechtites hieraciifolia (L.) Raf. ex DC.	American Burnweed	C=2	SAN 58
Erigeron annuus (L.) Pers.	Eastern Daisy Fleabane	C=0	SAN 497
Erigeron philadelphicus L.	Philadelphia Fleabane	C=3	Board 558
Erigeron strigosus Muhl. ex Willd.	Prairie Fleabane	C=2	SAN 437
Eupatorium perfoliatum L.	Common Boneset	C=4	SAN 571
Eurybia macrophylla (L.) Cass.	Bigleaf Aster	C=7	SAN 597
Euthamia graminifolia (L.) Nutt.	Flat-top Goldentop	C=3	SAN 566
Euthamia gymnospermoides Greene	Texas Goldentop	C=5	SAN 600
Hieracium caespitosum Dumort.	Meadow Hawkweed	*	Board 560
Hieracium gronovii L.	Queendevil	C=5	SAN 25
Hieracium × flagellare Willd. var. flagellare		*	SAN 422
Hypochaeris radicata L.	Hairy Cat's Ear	*	Board 610; SAN 423; SAN 608
Krigia virginica (L.) Willd.	Virginia Dwarfdandelion	C=4	Board 495
Lactuca biennis (Moench) Fernald	Tall Blue Lettuce	C=2	No Collection
Lactuca canadensis L.	Canada Lettuce	C=2	Board 691
Leucanthemum vulgare Lam.	Oxeye Daisy	*	Board 603
Prenanthes altissima L.	Tall Rattlesnakeroot	C=5	Board 724; SAN 65; SAN 624; SAN 628
Pseudognaphalium obtusifolium (L.) Hilliard & B.L. Burtt	Rabbit-tobacco	C=2	SAN 585; SAN 627
Solidago caesia L.	Wreath Goldenrod	C=7	SAN 67
Solidago canadensis L.	Canada Goldenrod	0	Board 725
Solidago juncea Aiton	Early Goldenrod	C=3	SAN 541
Solidago nemoralis Aiton	Gray Goldenrod	C=3	SAN 69
Solidago rugosa Mill.	Wrinkleleaf Goldenrod	C=6	SAN 70
Sonchus asper (L.) Hill	Spiny Sowthistle	*	SAN 511
Symphyotrichum dumosum (L.) G.L. Nesom var. dumosum	Rice Button Aster	C=4	SAN 54
Symphyotrichum lanceolatum (Willd). G.L. Nesom ssp. lanceolatum var. lanceolatum	White Panicle Aster	C=3	SAN 50
Symphyotrichum lateriflorum (L.) A. Love & D. Love var. lateriflorum	Calico Aster	C=3	SAN 64
Symphyotrichum pilosum (Willd.) G.L. Nesom var. pilosum	Hairy White Oldfield Aster	C=0	SAN 68
Taraxacum officinale F.H. Wigg.	Common Dandelion	*	SAN 161
Tragopogon dubius Scop.	Yellow Salsify	*	SAN 506
Xanthium strumarium L.	Rough Cocklebur	C=0	Board 726
BALSAMINACEAE (Touch-Me-Not Family)			
Impatiens capensis Meerb.	Jewelweed	C=2	Board 690

BERBERIDACEAE (Barberry Family)			
Berberis thunbergii DC.	Japanese Barberry	*	SAN 254
Podophyllum peltatum L.	Mayapple	C=3	Board 497
BETULACEAE (Birch Family)			
Alnus incana (L.) Moench ssp. rugosa (Du Roi) R.T. Clausen	Speckled Alder	C=9	SAN 111; SAN 159; SAN 288
Betula papyrifera Marsh.	Paper Birch	C=7	Board 633; SAN 109; SAN 126; SAN 157
Betula populifolia Marsh.	Gray Birch	C=10	SAN 42; SAN 148
Carpinus caroliniana Walter ssp. virginiana (Marsh.) Furlow	American Hornbeam	C=5	Board 602
Corylus americana Walter	American Hazelnut	C=4	SAN 106
Ostrya virginiana (Mill.) K. Koch	Hophornbeam	C=5	SAN 432
BRASSICACEAE (Mustard Family)			
Alliaria petiolata (M. Bieb.) Cavara & Grande	Garlic Mustard	*	Board 476
Barbarea vulgaris W.T. Aiton	Garden Yellowrocket	*	Board 477
Cardamine hirsuta L.	Hairy Bittercress	*	Board 478
Cardamine pensylvanica Muhl. ex Willd.	Pennsylvania Bittercress	C=2	Board 488
Lepidium campestre (L.) W.T. Aiton	Field Pepperweed	*	Board 517
Lepidium virginicum L.	Virginia Pepperweed	C=0	Board 713
Rorippa palustris (L.) Besser ssp. fernaldiana (Butters & Abbe) Jonsell	Fernald's Yellowcress	C=2	SAN 545
CAMPANULACEAE (Bellflower Family)			
Lobelia cardinalis L.	Cardinalflower	C=4	SAN 499
Lobelia inflata L.	Indian-tobacco	C=3	SAN 28
CAPRIFOLIACEAE (Honeysuckle Family)			
Lonicera canadensis Bartram ex Marsh.	American Fly Honeysuckle	C=10	SAN 152
Sambucus nigra L. ssp. canadensis (L.) R. Bolli	American Black Elderberry	C=2	No Collection
Viburnum acerifolium L.	Mapleleaf Viburnum	C=8	Board 569
Viburnum lentago L.	Nannyberry	C=5	SAN 294
Viburnum opulus L. var. opulus	European Cranberrybush	*	SAN 162
Viburnum prunifolium L.	Blackhaw	C=4	SAN 282
CARYOPHYLLACEAE (Pink Family)			
Arenaria serpyllifolia L.	Thymeleaf Sandwort	*	SAN 297

Cerastium pumilum W. Curtis	European Chickweed	*	Board 512
Cerastium semidecandrum L.	Fivestamen Chickweed	*	SAN 298
Dianthus armeria L.	Deptford Pink	*	Board 605
Saponaria officinalis L.	Bouncingbet	*	SAN 613
Scleranthus annuus L.	German Knotgrass	*	Board 616
Silene antirrhina L.	Sleepy Silene	*	SAN 475
Silene latifolia Poir. ssp. alba (Mill.) Greuter & Burdet	Bladder Campion	C=0	SAN 543
Stellaria media (L.) Vill.	Common Chickweed	*	Board 482
CELASTRACEAE (Staff-Tree Family)			
Celastrus orbiculatus Thunb.	Oriental Bittersweet	*	SAN 633
Euonymus obovatus Nutt.	Running Strawberry Bush	C=7	SAN 295
CERATOPHYLLACEAE (Hornwort Family)			
Ceratophyllum demersum L.	Coon's Tail	C=1	SAN 301
CHENOPODIACEAE (Family) [AMARANTHACEAE]			
Chenopodium album L.	Lambsquarters	*	Board 718; SAN 630
CLUSIACEAE (Mangosteen Family) [HYPERICACEAE]			
Hypericum boreale (Britton) E.P. Bicknell	Northern St. Johnswort	C=8	SAN 532
Hypericum canadense L.	Lesser Canadian St. Johnswort	C=8	No Collection
Hypericum majus (A. Gray) Britton	Large St. Johnswort	C=6	SAN 39; SAN 559
Hypericum perforatum L.	Common St. Johnswort	*	Board 672
Hypericum punctatum Lam.	Spotted St. Johnswort	C=3	SAN 513
Triadenum virginicum (L.) Raf.	Virginia Marsh St. Johnswort	C=10	SAN 75; SAN 569; SAN 614
CORNACEAE (Dogwood Family)			
Cornus florida L.	Flowering Dogwood	C=4	Board 491
Cornus obliqua Raf.	Silky Dogwood	C=5	SAN 450
Nyssa sylvatica Marsh.	Blackgum	C=5	Board 650
CRASSULACEAE (Family)			
Penthorum sedoides L.	Ditch Stonecrop	C=2	Board 694
CUCURBITACEAE (Cucumber Family)			
Sicyos angulatus L.	Oneseed Bur Cucumber	C=3	SAN 580

CUSCUTACEAE (Dodder Family) [CONVOLVULACEAE]			
Cuscuta gronovii Willd. ex Schult.	Scaldweed	C=2	Board 682
CYPERACEAE (Sedge Family)			
Carex albicans Willd. ex Spreng. var. emmonsii (Dewey ex Torr.) J. Rettig	Emmons' Sedge	C=5	Board 489; SAN 122; SAN 142; SAN 144; SAN 248; SAN 249
Carex albolutescens Schwein.	Greenwhite Sedge	C=9	Board 708
Carex arctata Boott ex Hook.	Drooping Woodland Sedge	C=10	Board 402; Board 508; SAN 24
Carex blanda Dewey	Eastern Woodland Sedge	C=1	Board 579
Carex brunnescens (Pers.) Poir.	Brownish Sedge	C=10	SAN 486
Carex cephalophora Muhl. ex Willd.	Oval-leaf Sedge	C=3	Board 666
Carex communis L.H. Bailey	Fibrousroot Sedge	C=8	Board 509; SAN 145
Carex comosa Boott	Longhair Sedge	C=6	SAN 424
Carex crinita Lam.	Fringed Sedge	C=8	Board 580
Carex debilis Michx. var. rudgei L.H. Bailey	White Edge Sedge	C=10	SAN 292
Carex digitalis Willd.	Slender Woodland Sedge	C=7	Board 544; Board 581; Board 597
Carex folliculata L.	Northern Long Sedge	C=10	SAN 32
Carex gracillima Schwein.	Graceful Sedge	C=7	Board 536
Carex granularis Muhl. ex Willd.	Limestone Meadow Sedge	C=2	Board 555
Carex intumescens Rudge	Greater Bladder Sedge	C=8	Board 598; Board 667; SAN 415; SAN 435
Carex laxiculmis Schwein. var. laxiculmis	Spreading Sedge	C=7	Board 599
Carex laxiflora Lam.	Broad Looseflower Sedge	C=7	Board 600; SAN 535
Carex longii Mack.	Long's Sedge	C=5	Board 635; SAN 26
Carex lupulina Muhl. ex Willd.	Hop Sedge	C=4	Board 636; Board 668, Board 680
Carex lurida Wahlenb.	Shallow Sedge	C=4	SAN 447
Carex muehlenbergii Schkuhr ex Willd. var. muehlenbergii	Muhlenberg's Sedge	C=5	SAN 504
Carex pensylvanica Lam.	Pennsylvania Sedge	C=5	Board 510
Carex radiata (Wahlenb.) Small	Eastern Star Sedge	C=4	Board 511
Carex rosea Schkuhr ex Willd.	Rosy Sedge	C=5	Board 537
Carex scoparia Schkuhr ex Willd.	Broom Sedge	C=4	SAN 29; SAN 568
Carex seorsa Howe	Weak Stellate Sedge	C=10	Board 539

Carex sparganioides Muhl. ex Willd.	Bur-reed Sedge	C=4	SAN 471
Carex stipata Muhl. ex Willd.	Awlfruit Sedge	C=2	Board 556
Carex stricta Lam.	Upright Sedge	C=5	Board 582
Carex swanii (Fernald) Mack.	Swan's Sedge	C=4	Board 583
Carex tonsa (Fernald) E.P. Bicknell var. rugosperma (Mack.) Crins	Parachute Sedge	C=9	Board 490; Board 538
Carex tonsa (Fernald) E.P. Bicknell var. tonsa	Shaved Sedge	C=9	Board 540; SAN 5; SAN 155; SAN 156
Carex tribuloides Wahlenb.	Blunt Broom Sedge	C=5	Board 712; SAN 22; SAN 467; SAN 485
Carex virescens Muhl. ex Willd.	Ribbed Sedge	C=8	Board 601; Board 637
Carex vulpinoidea Michx.	Fox Sedge	C=2	SAN 427
Cyperus lupulinus (Spreng.) Marcks ssp. macilentus (Fernald) Marcks	Great Plains Flatsedge	C=4	Board 640
Cyperus strigosus L.	Strawcolored Flatsedge	C=0	Board 683
Eleocharis engelmannii Steud.	Engelmann's Spikerush	C=4	SAN 518; SAN 557
Eleocharis obtusa (Willd.) Schult.	Blunt Spikerush	C=1	SAN 599
Fimbristylis autumnalis (L.) Roem. & Schult.	Slender Fimbry	C=3	SAN 558
Rhynchospora capitellata (Michx.) Vahl	Brownish Beaksedge	C=6	Board 674; SAN 40; SAN 523
Schoenoplectus tabernaemontani (C.C. Gmel.) Palla	Softstem Bulrush	C=4	No Collection
Scirpus atrovirens Willd.	Green Bulrush	C=4	SAN 527
Scirpus cyperinus (L.) Kunth	Woolgrass	C=4	SAN 59
ELAEAGNACEAE (Oleaster Family)			
Elaeagnus umbellata Thunb.	Autumn Olive	*	Board 541
ERICACEAE (Heath Family)			
Gaultheria procumbens L.	Eastern Teaberry	C=8	Board 644
Gaylussacia baccata (Wangenh.) K. Koch	Black Huckleberry	C=7	SAN 279
Vaccinium angustifolium Aiton	Lowbush Blueberry	C=5	SAN 285
Vaccinium corymbosum L.	Highbush Blueberry	C=9	Board 501; SAN 141; SAN 146
Vaccinium pallidum Aiton	Blue Ridge Blueberry	C=5	Board 527
EUPHORBIACEAE (Family)			
Acalypha rhomboidea Raf.	Common Threeseed Mercury	C=0	SAN 508
Croton glandulosus L. var. septentrionalis Mull. Arg.	Vente Conmigo	C=0	SAN 606
Chamaesyce nutans (Lag.) Small	Eyebane	C=0	SAN 572
Chamaesyce maculata (L.) Small	Spotted Sandmat	C=0	Board 688

FABACEAE (Pea Family)			
Amphicarpaea bracteata (L.) Fernald var. bracteata	American Hogpeanut	C=5	SAN 625
Apios americana Medik.	Groundnut	C=3	SAN 587
Desmodium ciliare (Muhl. ex Willd.) DC.	Hairy Small-leaf Ticktrefoil	C=3	SAN 539
Desmodium glabellum (Michx.) DC.	Dillenius' Ticktrefoil	C=3	SAN 544
Desmodium nudiflorum (L.) DC.	Nakedflower Ticktrefoil	C=5	SAN 560
Desmodium paniculatum (L.) DC.	Panicledleaf Ticktrefoil	C=2	SAN 540
Lespedeza hirta (L.) Hornem	Hairy Lespedeza	C=7	SAN 542
Medicago lupulina L.	Black Medick	*	Board 693
Melilotus alba Medikus	White Sweetclover	*	SAN 446
Robinia pseudoacacia L.	Black Locust	**	Board 709
Trifolium campestre Schreb.	Field Clover	*	SAN 451
Trifolium pratense L.	Red Clover	*	Board 568
Vicia villosa Roth	Winter Vetch	*	Board 619
FAGACEAE (Beech Family)			
Fagus grandifolia Ehrh.	American Beech	C=8	Board 514
Quercus alba L.	White Oak	C=5	Board 657
Quercus bicolor Willd.	Swamp White Oak	C=7	SAN 31; SAN 507
Quercus imbricaria Michx.	Shingle Oak	C=3	SAN 564
Quercus palustris Münchh.	Pin Oak	C=3	Board 591;Board 658
Quercus rubra L.	Northern Red Oak	C=4	SAN 442
Quercus velutina Lam.	Black Oak	C=4	SAN 538
GENTIANACEAE (Gentian Family)			
Bartonia virginica (L.) Britton, Sterns & Poggenb.	Yellow Screwstem	C=5	Board 678; SAN 74
GERANIACEAE (Geranium Family)			
Geranium maculatum L.	Spotted Geranium	C=4	Board 493
Geranium robertianum L.	Robert Geranium	C=4	SAN 521
GROSSULARIACEAE (Gooseberry Family)			
Ribes cynosbati L.	Eastern Prickly Gooseberry	C=4	Board 481
HALORAGACEAE (Water-Milfoil Family)			
Proserpinaca palustris L. var. crebra Fernald & Grisc.	Marsh Mermaidweed	C=4	SAN 466

HAMAMELIDACEAE (Witch-Hazel Family)			
Hamamelis virginiana L.	American Witchhazel	C=5	Board 516; SAN 53
IRIDACEAE (Iris Family)			
Iris virginica L. var. shrevei (Small) E.S. Anderson	Shreve's Iris	C=5	Board 562
Sisyrinchium angustifolium Mill.	Narrowleaf Blue-eyed Grass	C=3	Board 566
JUGLANDACEAE (Walnut Family)			
Carya cordiformis (Wangenh.) K. Koch	Bitternut Hickory	C=5	SAN 252
Carya ovata (Mill.) K. Koch	Shagbark Hickory	C=4	Board 584
JUNCACEAE (Rush Family)			
Juncus acuminatus Michx.	Tapertip Rush	C=4	Board 647
Juncus canadensis J. Gay ex Laharpe	Canadian Rush	C=7	SAN 38; SAN 55
Juncus effusus L.	Common Rush	C=3	Board 673
Juncus marginatus Rostk.	Grassleaf Rush	C=4	No Collection
Juncus scirpoides Lam.	Needlepod Rush	C=9	SAN 575
Juncus tenuis Willd.	Poverty Rush	C=0	Board 648
LAMIACEAE (Mint Family)			
Lamium purpureum L.	Purple Deadnettle	*	Board 479
Lycopus rubellus Moench.	Taperleaf Water Horehound	C=8	Board 692; SAN 76
Lycopus uniflorus Michx.	Northern Bugleweed	C=5	SAN 57; SAN 530
Monarda punctata L.	Spotted Beebalm	C=4	SAN 524
Prunella vulgaris L. ssp. lanceolata (W. Bartram) Hulten	Lance Selfheal	C=1	SAN 512
Scutellaria lateriflora L.	Blue Skullcap	C=4	SAN 528
Stachys tenuifolia Willd. var. hispida (Pursh) Fernald	Smooth Hedgenettle	C=4	SAN 496
LAURACEAE (Laurel Family)			
Lindera benzoin (L.) Blume	Northern Spicebush	C=5	Board 587; SAN 9; SAN 121
Sassafras albidum (Nutt.) Nees	Sassafras	C=1	Board 592
LEMNACEAE (Duckweed Family) [ARACEAE]			
Lemna minor L.	Common Duckweed	C=3	SAN 112
Lemna trisulca L.	Star Duckweed	C=6	SAN 93; SAN 113

LILIACEAE (Lily Family) [ALLIACEAE; RUSCACEAE; LILIACEAE]		
Allium canadense L.	Meadow Garlic	C=1 SAN 429
Maianthemum canadense Desf.	Canada Mayflower	C=8 Board 518
Maianthemum racemosum (L.) Link ssp. racemosum	Feathery False Lily of the Valley	C=7 SAN 284
Medeola virginiana L.	Indian Cucumber	C=8 Board 563
Polygonatum pubescens (Willd.) Pursh	Hairy Solomon's Seal	C=4 Board 498
LINACEAE (Family)		
Linum striatum Walter	Ridged Yellow Flax	C=5 Board 649; SAN 502; SAN 533
LYTHRACEAE (Loosestrife Family)		
Lythrum salicaria L.	Purple Loosestrife	* SAN 629
Rotala ramosior (L.) Koehne	Lowland Rotala	C=2 SAN 62
MAGNOLIACEAE (Magnolia Family)		
Liriodendron tulipifera L.	Tuliptree	C=4 Board 588; SAN 436
MALVACEAE (Mallow Family)		
Abutilon theophrasti Medik.	Velvetleaf	* No Collection
MELASTOMATACEAE (Family)		
Rhexia virginica L.	Handsome Harry	C=5 SAN 583
MONOTROPACEAE (Indian-Pipe Family) [ERICACEAE]		
Monotropa uniflora L.	Indianpipe	C=7 SAN 30
OLEACEAE (Olive Family)		
Fraxinus americana L.	White Ash	C=4 SAN 439
Fraxinus nigra Marsh.	Black Ash	C=7 SAN 33; SAN 477
Fraxinus pennsylvanica Marsh.	Red Ash	C=3 SAN 260
Fraxinus pennsylvanica Marsh. var. subintegerrima (Vahl) Fernald	Green Ash	C=1 SAN 34
ONAGRACEAE (Evening Primrose Family)		
Circaea lutetiana L. ssp. canadensis (L.) Asch. & Magnus	Broadleaf Enchanter's Nightshade	C=2 Board 681
Ludwigia alternifolia L.	Seedbox	C=3 SAN 498

Ludwigia palustris (L.) Elliot	Marsh Seedbox	C=3	SAN 525
Oenothera biennis L.	Common Evening Primrose	C=0	SAN 565
Oenothera laciniata Hill	Cutleaf Evening Primrose	C=2	SAN 492
ORCHIDACEAE (Orchid Family)			
Corallorhiza odontorhiza (Willd.) Poir.	Autumn Coralroot	C=3	Board 471
Epipactis helleborine (L.) Crantz	Broadleaf Helleborine	*	SAN PH-9
Goodyera pubescens (Willd.) R. Br.	Downy Rattlesnake Plantain	C=5	SAN PH-2; SAN PH-10
Platanthera clavellata (Michx.) Luer	Small Green Wood Orchid	C=9	SAN PH-5
Platanthera lacera (Michx.) G. Don	Green Fringed Orchid	C=4	SAN PH-7
Liparis liliifolia (L.) Rich. ex Ker Gawl.	Brown Widelip Orchid	C=3	SAN PH-4
Spiranthes cernua (L.) Rich.	Nodding Lady's Tresses	C=3	No Collection
Spiranthes ovalis Lindl. var. erostellata Catling	October Lady's Tresses	C=3	Board 727
OROBANCHACEAE (Family)			
Conopholis americana (L.) Wallr.	American Cancer-root	C=8	Board 513
Epifagus virginiana (L.) W. Bartram	Beechdrops	C=8	Board 721
OXALIDACEAE (Wood Sorrel Family)			
Oxalis stricta L.	Common Yellow Oxalis	C=0	SAN 296
PHYTOLACCACEAE (Family)			
Phytolacca americana L.	American Pokeweed	C=0	SAN 515
PLANTAGINACEAE (Plantain Family)			
Plantago lanceolata L.	Narrowleaf Plantain	*	Board 655
Plantago rugelii Decne.	Blackseed Plantain	C=0	SAN 573
PLATANACEAE (Family)			
Platanus occidentalis L.	American Sycamore	C=3	No Collection
POACEAE (Grass Family)			
Agrostis gigantea Roth	Redtop	*	Board 630; Board 665; SAN 36
Agrostis hyemalis (Walter) Britton, Sterns & Poggenb.	Winter Bentgrass	C=2	Board 594
Agrostis perennans (Walter) Tuck.	Upland Bentgrass	C=2	SAN 534
Andropogon virginicus L.	Broomsedge Bluestem	**	SAN 610

Aristida purpurascens Poir.	Arrowfeather Threeawn	C=7	SAN 72; SAN 607
Brachyelytrum aristosum (Michx.) Trel.	Northern Shorthusk	C=10	SAN 487; SAN 522
Brachyelytrum erectum (Schreb. ex Spreng.) P. Beauv.	Bearded Shorthusk	C=6	SAN 536
Bromus tectorum L.	Cheatgrass	*	SAN 491
Calamagrostis canadensis (Michx.) P. Beauv.	Bluejoint	C=5	Board 634; SAN 444
Cinna arundinacea L.	Sweet Woodreed	C=4	SAN 520; SAN 561
Dactylis glomerata L.	Orchardgrass	*	Board 585
Danthonia spicata (L.) P. Beauv. ex Roem. & Schult.	Poverty Oatgrass	C=3	Board 641; SAN 440
Dichanthelium acuminatum (Sw.) Gould & C.A. Clark var. fasciculatum (Torr.) Freckmann	Western Panicgrass	C=2	Board 653; SAN 23; SAN 609
Dichanthelium acuminatum (Sw.) Gould & C.A. Clark var. lindheimeri (Nash) Gould & C.A. Clark	Lindheimer Panicgrass	C=5	Board 654; SAN 470
Dichanthelium clandestinum (L.) Gould	Deertongue	C=3	Board 651; SAN 431; SAN 596
Dichanthelium clandestinum × depauperatum		NA	Board 652
Dichanthelium depauperatum (Muhl.) Gould	Starved Panicgrass	C=6	Board 564
Dichanthelium meridionale (Ashe) Freckmann	Matting Rosette Grass	C=7	Board 611
Dichanthelium oligosanthes (Schult.) Gould	Rosette Grass	C=6	SAN 474
Dichanthelium oligosanthes (Schult.) Gould var. scribnerianum (Nash) Gould	Scribner's Rosette Grass	C=6	Board 612
Dichanthelium sphaerocarpon (Elliot) Gould	Roundseed Panicgrass	C=5	Board 613
Digitaria cognata (Schult.) Pilg.	Fall Witchgrass	C=2	SAN 490; SAN 567
Digitaria ischaemum (Schreb.) Schreb. ex Muhl.	Smooth Crabgrass	*	SAN 586
Digitaria sanguinalis (L.) Scop.	Hairy Crabgrass	*	Board 720
Echinochloa crus-galli (L.) P. Beauv.	Barnyardgrass	*	Board 686
Elymus repens (L.) Gould	Quackgrass	*	SAN 489
Eragrostis spectabilis (Pursh) Steud.	Purple Lovegrass	C=3	SAN 71
Festuca ovina L.	Sheep Fescue	*	Board 608
Festuca subverticillata (Pers.) Alexeev	Nodding Fescue	C=4	Board 607
Glyceria septentrionalis Hitchc.	Floating Mannagrass	C=7	Board 671
Glyceria striata (Lam.) Hitchc.	Fowl Mannagrass	C=4	Board 609
Holcus lanatus L.	Common Velvetgrass	*	Board 646; SAN 27
Leersia oryzoides (L.) Sw.	Rice Cutgrass	C=2	SAN 631
Leersia virginica Willd.	Whitegrass	C=4	SAN 562
Muhlenbergia frondosa (Poir.) Fernald	Wirestem Muhly	C=3	Board 723
Muhlenbergia mexicana (L.) Trin.	Mexican Muhly	C=4	SAN 590
Panicum rigidulum Bosc ex Nees	Redtop Panicgrass	C=4	SAN 61

Paspalum setaceum Michx. var. stramineum (Nash) D. Banks	Thin Paspalum	C=3	Board 715
Phalaris arundinacea L.	Reed Canarygrass	*	SAN 425
Phleum pratense L.	Timothy	*	SAN 441
Poa annua L.	Annual Bluegrass	*	Board 523
Poa alsodes A. Gray	Grove Bluegrass	C=8	Board 522; SAN 256
Poa compressa L.	Canada Bluegrass	*	Board 614
Poa pratensis L.	Kentucky Bluegrass	*	Board 524
Schenodonorus phoenix (Scop.) Holub	Tall Fescue	*	Board 559
Schizachyrium scoparium (Michx.) Nash var. scoparium	Little Bluestem	C=4	SAN 612
Setaria faberi Herrm.	Japanese Bristlegrass	*	Board 697
Setaria pumila (Poir.) Roem. & Schult. ssp. pumila	Yellow Foxtail	*	Board 698
Torreyochloa pallida (Torr.) Church var. pallida	Pale False Mannagrass	C=10	Board 458; Board 645; SAN 443
Tridens flavus (L.) Hitchc. var. flavus	Purpletop Tridens	**	Board 699; SAN 73
Vulpia octoflora (Walter) Rydb.	Sixweeks Fescue	C=1	Board 620
POLYGALACEAE (Milkwort Family)			
Polygala polygama Walter	Racemed Milkwort	C=7	Board 656
POLYGONACEAE (Smartweed Family)			
Polygonum careyi Olney	Carey's Smartweed	C=10	SAN 576
Polygonum hydropiperoides Michx.	Swamp Smartweed	C=3	Board 696; SAN 35; SAN 63
Polygonum pensylvanicum L.	Pennsylvania Smartweed	C=0	SAN 588
Polygonum persicaria L.	Spotted Ladysthumb	*	SAN 577
Polygonatum sagittatum L.	Arrowleaf Tearthumb	C=4	SAN 589
Polygonum scandens L.	Climbing False Buckwheat	C=0	SAN 578
Polygonum virginianum L.	Jumpseed	C=3	SAN 519
Rumex acetosella L.	Common Sheep Sorrel	*	Board 526
Rumex crispus L.	Curly Dock	*	SAN 468
PORTULACACEAE (Purslane Family)			
Claytonia virginica L.	Virginia Springbeauty	C=2	Board 472; SAN 16; SAN 125
POTAMOGETONACEAE (Pondweed Family)			
Potamogeton foliosus Raf.	Leafy Pondweed	C=4	SAN 510

PRIMULACEAE (Primrose Family)			
Lysimachia ciliata L.	Fringed Loosestrife	C=4	SAN 488
Lysimachia thyrsiflora L.	Tufted Loosestrife	C=7	SAN 426
Trientalis borealis Raf.	Starflower	C=10	Board 500
PYROLACEAE (Shin-Leaf Family) [ERICACEAE]			
Chimaphila maculata (L.) Pursh	Striped Prince's Pine	C=4	Board 639
Pyrola elliptica Nutt.	Waxflower Shinleaf	C=8	SAN 44
RANUNCULACEAE (Buttercup Family)			
Actaea pachypoda Elliot	White Baneberry	C=7	SAN 45; SAN 255
Anemone quinquefolia L.	Wood Anemone	C=7	SAN 283
Coptis trifolia (L.) Salisb.	Threeleaf Goldthread	C=10	Board 473; SAN 140
Ranunculus abortivus L.	Littleleaf Buttercup	C=0	Board 480; SAN 12
Ranunculus acris L.	Tall Buttercup	*	Board 565
Ranunculus flabellaris Raf.	Yellow Water Buttercup	C=7	SAN 259
Ranunculus recurvatus Poir.	Blisterwort	C=5	Board 544
ROSACEAE (Rose Family)			
Agrimonia parviflora Aiton	Harvestlice	C=4	SAN 574
Amelanchier laevis Wiegand	Allegheny Serviceberry	C=8	SAN 139; SAN 143; SAN 149
Crataegus crus-galli L.	Cockspur Hawthorn	C=4	SAN 503
Crataegus flabellata (Bosc ex Spach) K. Koch	Fanleaf Hawthorn	NA	SAN 257
Crataegus mollis Scheele	Downy Hawthorn	C=2	SAN 253
Fragaria virginiana Duchesne	Virginia Strawberry	C=2	Board 492
Geum canadense Jacq.	White Avens	C=1	SAN 430; SAN 469
Malus ioensis (Alph. Wood) Britton	Prairie Crab Apple	C=3	SAN 563
Photinia floribunda (Lindl.) K.R. Robertson & Phipps	Purple Chokeberry	C=8	Board 506
Potentilla simplex Michx.	Common Cinquefoil	C=2	Board 499
Prunus pensylvanica L. f.	Pin Cherry	C=2	SAN 494
Prunus serotina Ehrh.	Black Cherry	C=1	Board 590
Prunus virginiana L.	Chokecherry	C=3	SAN 258
Rosa multiflora Thunb.	Multiflora Rose	*	SAN 147; SAN 428
Rosa palustris Marsh.	Swamp Rose	C=5	Board 660
Rubus allegheniensis Porter	Allegheny Blackberry	C=2	Board 545; SAN 414
Rubus enslenii Tratt.	Dewberry	C=5	Board 525

Rubus flagellaris Willd.	Northern Dewberry	C=2	SAN 420
Rubus hispidus L.	Bristly Dewberry	C=6	Board 661
Rubus idaeus L. ssp. strigosus (Michx.) Focke	Grayleaf Red Raspberry	C=4	SAN 617
Rubus occidentalis L.	Black Raspberry	C=1	SAN 413
Rubus pensilvanicus Poir.	Pennsylvania Blackberry	NA	SAN 417
Sorbus aucuparia L.	European Mountain Ash	*	SAN 280
Spiraea alba Du Roi	White Meadowsweet	C=4	SAN 516
Spiraea tomentosa L.	Steeplebush	C=4	SAN 517
RUBIACEAE (Madder Family)			
Cephalanthus occidentalis L.	Common Buttonbush	C=5	Board 638
Diodia teres Walter var. teres	Poorjoe	C=2	SAN 537
Galium aparine L.	Stickywilly	C=1	Board 515
Galium circaezans Michx. var. circaezans	Licorice Bedstraw	C=7	Board 689
Galium circaezans Michx. var. hypomalacum Fernald	Licorice Bedstraw	C=5	SAN 476
Galium concinnum Torr. & A. Gray	Shining Bedstraw	C=5	SAN 500
Galium lanceolatum Torr.	Lanceleaf Wild Licorice	C=7	SAN 433
Galium obtusum Bigelow	Bluntleaf Bedstraw	C=5	SAN 419
Galium pilosum Aiton	Hairy Bedstraw	C=5	SAN 493
Galium tinctorium (L.) Scop.	Stiff Marsh Bedstraw	C=6	SAN 445
Galium triflorum Michx.	Fragrant Bedstraw	C=5	Board 643
Mitchella repens L.	Partridgeberry	C=8	Board 589
SALICACEAE (Willow Family)			
Populus deltoides Bartram ex Marsh.	Eastern Cottonwood	C=1	SAN 448
Populus grandidentata Michx.	Bigtooth Aspen	C=4	SAN 129
Populus tremuloides Michx.	Quaking Aspen	C=2	SAN 89; SAN 90; SAN 91
Populus × canescens (Aiton) Sm. (pro sp.) [alba × tremula]	Gray Poplar	*	Board 422
Salix discolor Muhl.	Pussy Willow	C=3	SAN 110; SAN 160; SAN 287
Salix myricoides Muhl. var. myricoides	Bayberry Willow	C=9	SAN 124; SAN 158; SAN 250; SAN 601
Salix nigra Marsh.	Black Willow	C=3	SAN 60; SAN 300
Salix petiolaris Sm.	Meadow Willow	C=6	SAN 56; SAN 251
SAURURACEAE (Family)			
Saururus cernuus L.	Lizard's Tail	C=4	Board 662

SCROPHULARIACEAE (Figwort Family) [PLANTAGINACEAE; LINDERNIACEAE; PHRYMACEAE; SCROPHULARIACEAE]			
Chelone glabra L.	White Turtlehead	C=7	SAN 626
Gratiola neglecta Torr.	Clammy Hedgehyssop	C=4	SAN 501
Gratiola virginiana L.	Roundfruit Hedgehyssop	C=4	SAN 43
Lindernia dubia (L.) Pennell var. anagallidea (Michx.) Cooperr.	Yellowseed False Pimpernel	C=2	SAN 598
Lindernia dubia (L.) Pennell var. dubia	Yellowseed False Pimpernel	C=3	SAN 584
Mimulus ringens L.	Allegheny Monkeyflower	C=3	SAN 602
Nuttallanthus canadensis (L.) D.A. Sutton	Canada Toadflax	C=4	Board 496
Verbascum blattaria L.	Moth Mullein	*	SAN 452
Verbascum thapsus L.	Common Mullein	*	SAN 505
Veronica arvensis L.	Corn Speedwell	*	Board 618
Veronica scutellata L.	Skullcap Speedwell	C=9	Board 700
SMILACACEAE (Cat-Brier Family)			
Smilax rotundifolia L.	Roundleaf Greenbrier	C=4	SAN 281
SOLANACEAE (Nightshade Family)			
Solanum carolinense L.	Carolina Horsenettle	C=0	Board 716
Solanum dulcamara L.	Climbing Nightshade	*	Board 567
Solanum ptycanthum Dunal	West Indian Nightshade	C=0	SAN 529
SPARGANIACEAE (Bur-Reed Family) [TYPHACEAE]			
Sparganium americanum Nutt.	American Bur-reed	C=10	SAN 495
TILIACEAE (Linden Family) [MALVACEAE]			
Tilia americana L.	American Basswood	C=5	Board 711
ULMACEAE (Elm Family) [CANNABACEAE; ULMACEAE]			
Celtis occidentalis L.	Common Hackberry	C=3	No Collection
Ulmus americana L.	American Elm	C=3	SAN 107
URTICACEAE (Nettle Family)			
Boehmeria cylindrica (L.) Sw.	Smallspike False Nettle	C=3	Board 679; SAN 52
Pilea pumila (L.) A. Gray	Canadian Clearweed	C=2	Board 695; SAN 51
VERBENACEAE (Vervain Family)			
Verbena hastata L.	Swamp Verbena	C=3	SAN 509

VIOLACEAE (Violet Family)			
Viola affinis Leconte	Sand Violet	C=2	Board 502
Viola blanda Willd. var. palustriformis A. Gray	Sweet White Violet	C=8	SAN PH-1; SAN 123
Viola cucullata Aiton	Marsh Blue Violet	C=8	SAN 293
Viola labradorica Schrank	Alpine Violet	C=7	Board 483
Viola lanceolata L.	Bog White Violet	C=9	Board 546
Viola macloskeyi Lloyd ssp. pallens (Banks ex Ging) M.S. Baker	Smooth White Violet	C=10	SAN 10; SAN 154
Viola pubescens Aiton	Downy Yellow Violet	C=5	Board 474; SAN 13; SAN 151
Viola rostrata Pursh	Longspur Violet	C=8	Board 475
Viola sororia Willd.	Common Blue Violet	C=1	Board 484; SAN 14; SAN 150; SAN 153
VITACEAE (Grape Family)			
Parthenocissus quinquefolia (L.) Planch.	Virginia Creeper	C=2	SAN 449
Vitis aestivalis Michx.	Summer Grape	C=4	SAN 472; SAN 473
Vitis labrusca L.	Fox Grape	C=1	SAN 421
Vitis riparia Michx.	Riverbank Grape	C=6	SAN 299
Additional taxa not identified to species			
Platanthera Rich.	Fringed Orchid	NA	SAN PH-8
Platanthera Rich.	Fringed Orchid	NA	SAN PH-6
Typha L.	Cattail	NA	No Collection
Vernonia Schreb.	Ironweed	NA	No Collection

* Non-native

** Native in Indiana (Rothrock 2004), non-native in Chicago Region (Swink & Wilhelm 1994), considered non-native; or obviously introduced at site

APPENDIX 2. Published Indiana Floristic Inventories.

Site Name, Location	Size (ac)	Total Species	Native Species	Total Mean-C	Native Mean-C	Total FQI	Native FQI
Barker Woods Nature Preserve, LaPorte County[2]	29.7	159	146	4.6	5.0	58.4	60.7
Bendix Woods Nature Preserve, St. Joseph County[2]	27.2	118	112	4.4	4.7	48.1	49.3
Big Oaks National Wildlife Area (3 sample areas)[2]		51	39	2.2	2.9	15.8	18.0
Botany Glen, Grant County[2]	44.5	357	295	3.3	4.0	62.3	68.5
Fall Creek Gorge Nature Preserve, Warren County[2]	148.3	346	288	3.1	3.8	58.5	64.1
Flint Barrens, Harrison County[2]	59.3	289	276	3.9	4.0	65.6	67.2

Fogwell Forest Nature Preserve, Allen County[2]	27.2	240	210	3.6	4.1	55.4	59.3
Fox Lake Littoral Zone, Steuben County[2]		30	29	5.2	5.4	28.7	29.2
Ginn Woods, Delaware County[2]	150.7	441	364	3.2	3.9	67.3	74.1
Hemlock Bluff Nature Preserve, Jackson County[2]	39.5	299	259	3.5	4.0	60.4	64.9
IMI Fen, Henry County[3]	6.2	287	246				
Lick Creek Summit Nature Preserve, Wayne County[4]	39.0	387	304				
Lime Lake Nature Preserve, Steuben County[2]	49.4	75	71	6.0	6.3	52.0	53.4
Little Calumet Headwaters Nature Preserve, LaPorte County[1]	108.0	298	271	4.1		70.1	
Lookout Point Gravel Hill Prairie, Tippecanoe County[2]	< 2.5	84	74	4.3	4.9	39.2	39.2
Mounds State Park Fen, Madison County[2]	4.9	97	96	5.9	5.9	57.7	58.0
Mounds State Park Floodplain Forest and Seeps, Madison County[2]		146	130	3.5	4.0	42.6	45.2
Mounds State Park, Madison County[2]	259.5	448	380	3.8	4.5	80.4	87.3
Perry County Limestone Glade, Perry County[2]	< 2.5	47	47	5.2	5.2	35.7	35.7
Perry County Sandstone Glade, Perry County[2]	< 2.5	32	32	4.8	4.8	27.2	27.2
Plaster Creek Seep Springs, Martin County[2]	< 2.5	107	107	5.2	5.2	53.6	53.6
Saugany Lake, LaPorte County[2]	74.1	47	43	4.4	4.9	30.5	31.9
Seasonal Pond and Margin on Taylor University campus, Grant County[2]	4.9	36	27	2.1	2.7	12.3	14.2
Sebert Property, LaPorte County	39.0	434	362	3.7	4.4	76.0	83.3
Turkey Run State Park Seep Area 1, Parke County[2]	< 2.5	32	30	5.1	5.4	28.8	29.8
Turkey Run State Park Seep Area 2, Parke County[2]	< 2.5	43	40	4.0	5.1	31.0	32.1
Twin Swamp Nature Preserve, Posey County[2]	598.0	138	125	3.3	3.6	38.2	40.2
Upland Prairie Restoration (12th year)[2]		67	46	2.5	3.7	20.8	25.1
Upland Prairie Restoration (5th year), Grant County[2]	24.7	65	36	1.8	3.2	14.4	19.3
Versailles State Park Limestone Glade, Ripley County[2]	< 2.5	83	80	4.2	4.4	38.3	39.0
Wabash Breaks Gravel Hill Prairie, Tippecanoe County[2]	< 2.5	102	92	3.9	4.3	38.9	41.0
Wea Creek Gravel Hill Prairie, Tippecanoe County[2]	< 2.5	89	76	3.4	4.0	32.4	35.1
Wening-Sherrit Seep Springs, Dubois County[2]	< 2.5	93	90	5.2	5.3	49.9	50.7
Wilbur Wright Fish and Wildlife Area[2]	1028.0	536	388	2.8	3.9	65.8	77.3
Yellow Birch Ravine Nature Preserve, Crawford County[2]	434.9	420	385	4.2	4.6	86.5	90.4

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A CHECKLIST OF VASCULAR PLANTS OF THE LAPEER STATE GAME AREA, LAPEER COUNTY, MICHIGAN, USA

Joshua C. Springer* and Bruce D. Parfitt†
University of Michigan-Flint
Department of Biology
Flint, Michigan, USA 48502
Email: spring47@msu.edu

ABSTRACT

A checklist of vascular plant species resulting from collections made 2003 to 2009 at the Lapeer State Game Area located in Lapeer County, Michigan is presented. A total of 602 species in 119 plant families were collected; native plants represented 457 of the species (75.9%) while species non-native to Michigan represented the remaining 145 (24.1%) of the flora. Asteraceae, Poaceae, and Cyperaceae had the most species represented in the game area with 68, 48, and 40 species in each, respectively; those three families contained over 25% of all species collected in the game area. Additionally, three species listed as threatened in the state of Michigan were found.

INTRODUCTION

The Lapeer State Game Area, (LSGA) encompasses more than 9,000 acres of Michigan Department of Natural Resources and Environment (MDNRE) administered land in four townships in central-northern Lapeer County, Michigan, USA. The LSGA is located approximately 30 miles east-northeast of the city of Flint, Michigan and 50 miles west-northwest of Port Huron, Michigan. Presented here is a brief historical, physical, and ecological description of the LSGA followed by a checklist of vascular plants collected within LSGA borders from 2003 to 2009. Potential future research directions at this large game area in southeastern Michigan are presented after the species checklist.

Much of the historical information contained herein was obtained from extensive unpublished LSGA files made by Harry House, (ex-MDNRE employee), personal communications of long-serving MDNRE employees closely tied to the game area, and an unpublished document created for the use of LSGA employees to acquaint themselves with the area entitled "An abbreviated history of the Lapeer State Game Area" written by fisheries biologist, Joe Leonardi in early 2004.

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*Present address: Michigan State University, Department of Plant Biology and the Ecology, Evolutionary Biology and Behavior program (EEBB), East Lansing, Michigan, USA 48824
†Deceased

HISTORICAL INFORMATION: A BRIEF ANCIENT HISTORY

A floristic survey conducted 11,000 years before present would have presumably yielded a much different list of species than submitted here. In fact, Kapp (1986), showed just that through pollen analysis conducted in association with a radiocarbon dating study on the famed "Rappuhn Mastodont" mastodon skull discovered near the present-day LSGA. Pollen preserved in soil within the skull showed that a forest dominated by spruces and sedges was common in the area surrounding LSGA and probably much of Lapeer county. In fact, a slow progression of spruce to pine and then to hardwoods is shown in Kapp's analysis and others (e.g., Bailey and Ahearn, 1981) owing to a presumed rapidly changing climate after continued glacial retreat about 10,000 to 9,000 years ago. Mastodons are thought to have had remnant populations in refugia of spruce forests that persisted for several hundred years after the larger, regional demise of this ecotype as the climate warmed (King and Saunders 1984). Species such as *Picea glauca* (Moench.) Voss, were apparently common, representing upward of 60—70% of the pollen diagram generated by Kapp (1986). However, this species was not found within LSGA borders but is restricted to a bog associated with Fish Lake, on the property of Eastern Michigan University's Kresge center, adjacent to LSGA. Other species, such as *Populus spp.*, *Salix spp.*, and *Potamogeton spp.*, became more common as the climate warmed, (Kapp, 1986) and are common to abundant within the borders of the LSGA.

RECENT HISTORY

The MDNRE began acquiring land for the present game area in 1955 after a large portion of the estate of James Vernor (of Vernor's Ginger Ale fame) was sold to the state of Michigan for the sum of $242,000. Smaller acreages were obtained thereafter, along with subsequent land consolidations, eventually combining many large ranches and farms which contained special habitats that continue to thrive today. Two townships now containing game area property, Mayfield and Arcadia, were first settled by Europeans in 1833 and 1842, respectively (Ellis, 1978). Native American artifacts were reportedly found during the Vernor's home construction in the early 20th century near Long Lake (MDNRE unpublished notes) and suggest their presence in present-day LSGA before European settlement. Native Americans were presumed to have been present in present-day LSGA and may have killed or scavenged from the mastodon noted above (Kapp 1986) long before any European exploration or settlement. Mayfield and Arcadia Township's land was first purchased by settlers in the 1830s for around $1.25 per acre but was almost immediately sold to lumbering interests (MDNRE unpublished notes; Ellis 1978). In 1836, Arcadia Township was principally owned by a lumbering baron from Kalamazoo named Lucius Lyon who owned property in all 36 sections. His properties were composed of 22 entire sections including the large block of sections 1 through 13. By 1870 the lumber industry was utilizing stands of eastern white pine (*Pinus strobus* L.) and

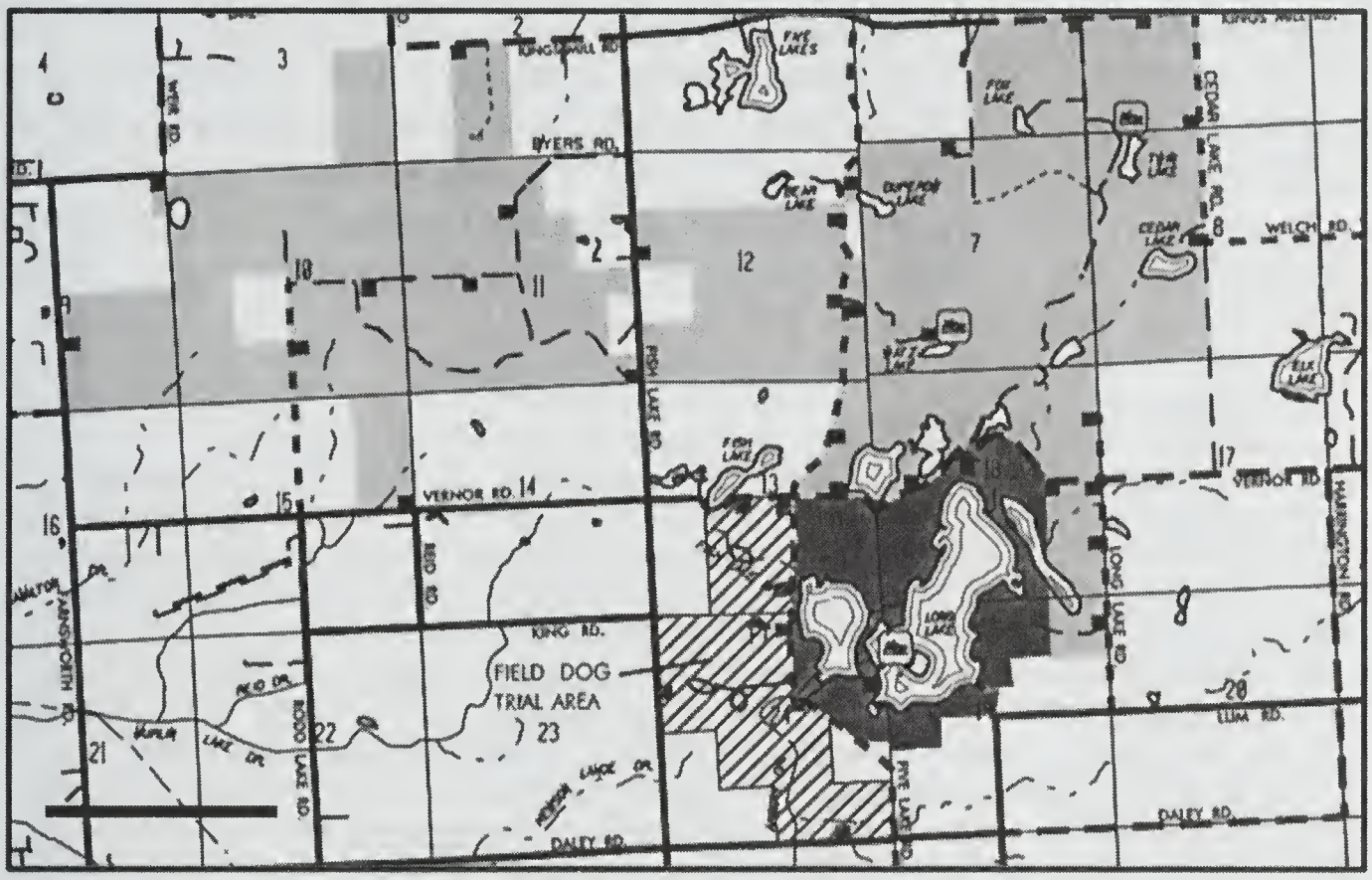

FIGURE 1. Modified MDNRE map showing easternmost sections of the LSGA containing some of the most modified habitats in the 9,000 acre game area including the field dog trail area (cross-hatches) and wildlife refuge (darkest shading) which has numerous field plots and mowed or otherwise maintained areas.

later, hardwood (exact species unknown but presumably oaks). An 1874 atlas of the county shows 10 lumber mills in Mayfield Township and 3 in Arcadia. Two of the largest mills were located at Five Lakes and at Fish Lake now owned by Eastern Michigan University (Kresge Environmental Center).

By 1880 much of the large timber in the area had been depleted and in 1881 lumbering at the Five lakes mill ended followed by Stephens Mill in 1886. A branch of the Detroit and Bay City Railway was removed in 1890, just 17 years after being constructed. With large areas clear of timber, the main industry in the area quickly became agriculture. Previous timber land holdings were sold, turned to agriculture and purchased again for the purpose of summer vacation estates. As early as 1931 it appears that around 6% of the land in Lapeer county was being used as summer estates and country homes for businessmen from the Detroit area. Five tracts of land of over 1000 acres each were owned in Mayfield township by Detroit businessmen such as James Vernor and S. P. Conklin.

Numerous lakes and marshes dot the landscape of the LSGA. Long Lake, the largest lake within game area borders, and the location of the Vernor homestead, (within the area where the first plant collections were made) is closed for a portion of the year to fisherman. Land immediately surrounding the lake is within the boundaries of a wildlife refuge where access is discouraged year-round (Figure 1). According to MDNRE policy the initial closure of the lake area in the mid 1950s was done so that Canada geese "could become acclimated" to the area. The annual closure of the lake still occurs, a relic policy from when the geese were much rarer than present. The water level of Long Lake is managed by a series of dikes creating shallow marshy floodings adjacent to the main water body,

adding much acreage of wetland to the game area (Springer and Parfitt pers. obs.). Sawdel, Twin, and Watz lakes also have water control valves or dikes that create marshy areas, although these are significantly smaller than the flooded area at Long Lake. MDNRE raises or lowers water levels according to management schemes or maintenance schedules. Other lakes within LSGA borders have water levels that are not directly human-influenced (Cedar, Duperow, Fox, Margret, and many unnamed lakes).

METHODS

The Lapeer State Game Area was visited numerous times during the growing seasons of 2003, 2004, and 2005 with additional collecting trips made during the years 2006–2009. Nearly 1,400 voucher specimens were collected, identified, and deposited in the University of Michigan-Flint herbarium (UMF), Flint, Michigan. An incomplete collection of duplicates was sent to the University of Michigan herbarium (MICH), Ann Arbor, Michigan; Michigan State University herbarium (MSC), East Lansing, Michigan; and the University of Wisconsin-Osh-Kosh, (OSH), Osh-Kosh, Wisconsin. Specimens deposited at the above herbaria have their acronym (MICH, MSC, or OSH) following the author's collection number in the checklist provided. Identification was achieved using the Michigan Flora (Voss 1972, 1985, 1996) with some species requiring the Jepson Manual of the higher plants of California (Hickman 1993). Nomenclature follows that of Voss (1972, 1985, 1996) with newer nomenclature in parentheses, following the new Michigan Flora volume (unpublished manuscript provided by Tony Reznicek).

All habitat types were sampled repeatedly throughout each growing season. Easily accessible habitats such as trails and parking lots were most extensively collected but off-trail hikes yielded species that otherwise would not have been collected. Every effort was made to visit all major sections and habitats of the game area at various times during the growing season throughout the seven collecting years.

RESULTS AND DISCUSSION

A total of 602 species in 119 families are represented at the LSGA with doubtless others present in very localized populations (Table 1; Appendix). Approxi-

TABLE 1. Plant families represented by more than 10 species in the LSGA and the percentage of the total number of species (602) they account for within the game area.

Family	Species	% of Total
Asteraceae	68	11.29
Poaceae	48	7.97
Cyperaceae	40	6.64
Rosaceae	36	5.98
Fabaceae	22	3.65
Liliaceae	19	3.15
Ranunculaceae	17	2.77
Brassicaceae	16	2.65
Salicaceae	15	2.49
Lamiaceae	16	2.65
Polygonaceae	14	2.32
Caprifoliaceae	13	2.15
Apiaceace	13	2.15
Others	265	44.1

TABLE 2. Species known by the authors to have been recently planted by MDNRE personnel; some do not persist for long time periods after planting (some, therefore may not consider these species part of the flora). These species were generally not found outside of the disturbed planted areas. Prairie plots are near the Field Dog Trial area on Five Lakes road and Food Plots are scattered throughout the game area but are most common in eastern sections.

Family	Species	Location
Poaceae	*Andropogon gerardii*	Prairie
Poaceae	*Lolium perenne*	Food Plots
Poaceae	*Sorghum bicolor*	Food Plots
Poaceae	*Zea mays*	Food Plots
Polygonaceae	*Fagopyrum esculentum*	Food Plots
Papaveraceae	*Papaver rhoeas*	Prairie
Brassicaceae	*Erysimum capitatum*	Prairie
Brassicaceae	*Hesperis matronalis*	Prairie
Fabaceae	*Medicago lupulina*	Food Plots
Fabaceae	*Medicago sativa*	Food Plots
Fabaceae	*Trifolium hybridum*	Food Plots
Fabaceae	*Trifolium pratense*	Food Plots
Linaceae	*Linum perenne*	Prairie
Hydrophyllaceae	*Nemophila menziesii*	Prairie
Asteraceae	*Echinacea purpurea*	Food Plots
Asteraceae	*Helianthus annus*	Food Plots

mately 24% of the species are non-native. Thirteen families are represented by at least 10 species at LSGA (Table 2). A general overview of LSGA, representing the easternmost sections (shaded portions in Figure 1) and the less modified, westernmost sections of the game area (Figure 2) shows the large size of the game area. Habitat modification has had a major impact on the flora in the eastern section of the game area, especially in areas surrounding Long Lake; and the "Field Dog Trial Area" west of Five Lakes Road. Many non-native species occur in mowed grassy areas maintained by the MDNRE which include wildlife food and wildflower plantings (Figure 3 and Table 2), including at least two that required identification using The Jepson Manual of higher plants of California (1993). Although these are maintained areas, the species that have been introduced could spread into more permanent habitats and were documented for future reference. Roadside and trailside collections contain abundant non-native species especially where trails or roads lead to lakes that are heavily fished or where trails are planted with grass-forb mixes to prevent erosion.

An island within Long Lake provides a refuge for at least one threatened species in Michigan, *Astragalus canadensis* L., (Fabaceae), Canada Milk-vetch. Unfortunately this species was found only once in dense grass growth in 2003; further collecting might prove this species more common. One forest seemed especially less modified than others and contained riparian habitat on the northern branch of the Flint River in the northwestern-most section of the game area (Figures 2 and 4). Another threatened species, *Hydrastis canadensis* L. (Ranunculaceae) was found to be thriving in three subpopulations with over 450 ramets present in 2004. Lastly, *Zizania aquatica* L.; Southern Wild Rice, another threat-

FIGURE 2. Modified MDNRE map of the western sections of the LSGA with northwestern-most section containing confluence of the north and south branches of the Flint River. Sawdel Lake fen is found to the southeast surrounded by a large contiguous land block.

ened species, was abundant in wetlands at the northern edge of Sawdel Lake (Figure 5), creating a large monoculture.

Aquatic habitats, both natural and man-made, are an important part of the physical feature of the game area and contain species not found elsewhere in the LSGA. A bog at the northeastern end of Cedar Lake (Figure 1), although invaded by grasses and woody species, still harbors common bog species. In addition, a fen is located at the southern end of Sawdel Lake in one of the western sections of the game area (Figure 2). This habitat is difficult to access because of a lack of roads and hiking trails, possibly preventing exploitation of some of its species. Three species documented for the LSGA were found only at the fen of Sawdel Lake: *Calopogon tuberosus* (Figure 6), *Cypripedium reginae* (Figure 7), and *Triglochin palustre* (Figure 8). Only five stems of *Triglochin palustre* were

FIGURE 3. MDNRE habitat food plot near Long Lake in the eastern part of the game area. Yearly mowing and planting with annual food crops make these highly disturbed areas and sum to an estimated 250 acres of modified land. Photo by J.C. Springer.

FIGURE 4. River floodplain habitat near confluence of north and south branches of the Flint River in northwestern part of the LSGA. Photo by J.C. Springer.

FIGURE 5. Sawdel Lake with abundant *Typha* sp. and threatened species *Zizania aquatica.* Fen habitat is at center of photo, spreading nearly the entire width of the frame. Photo by J.C. Springer.

found while the two orchids were common to abundant. Although found at the bog near Cedar Lake, *Sarracenia purpurea* (Figure 9) was also abundant at the Sawdel Lake fen. Another carnivorous species, *Drosera rotundifolia* (Figure 10) was common, especially in more open habitats but was found in shaded areas with the overstory species *Thuja occidentalis* and *Larix laricina* (Figure 11) at the margin of the fen. Common species we found in most aquatic habitats were *Utricularia vulgaris* L., *Potamogeton illinoensis*, *P. zosteriformis*, *P. natans, Lemna sp*., and *Typha sp*.

Much of the eastern part of the LSGA surrounding Long Lake was owned by James Vernor from the mid 19th century until 1955 when it was sold to the state of Michigan. According to MDNRE notes, much of that land was pasture for horses which, as noted on voucher specimens, has subsequently re-grown into secondary forest with remnant horse-riding trails still used by MDNRE personnel to access habitat plantings and dike control structures on man-made lakes and marshy floodings (Figure 12). Many non-native, invasive plants can be found in these previous pasture areas; some of the most common are spotted knapweed, (*Centaurea stoebe* L.) and autumn olive (*Elaeagnus sp*.). Although the list of species below contains numerous non-natives and potentially invasive species, most of them are thankfully uncommon and restricted to edge habitats, parking lots, and most roadsides. Old homesites incorporated into the game area property are also areas where many non-native garden plants or ornamentals can

FIGURE 6. Close-up of Grass-pink (*Calopogon tuberosus*), Michigan's only non-resupinate orchid (the lip of this species is not rotated to be the lower petal as in other many other orchids). This species was found only at the fen of Sawdel Lake. Photo by J.C. Springer.

FIGURE 7. Showy Lady-slipper (*Cypripedium reginae*) found only at the fen of Sawdel Lake and other wet areas surrounding the lake margin. Some stems of this species were near one meter tall. Photo by J.C. Springer.

be found including Colorado blue spruce (*Picea pungens* Engelmann), common lilac (*Syringa vulgaris* L.) and daylily (*Hemerocallis fulva* (L.) L.). There is no active program for non-native species removal at LSGA.

FUTURE WORK

Studies of special habitats such as boggy areas and the fen should be carried out to investigate whether plant biodiversity within those areas is stable or declining due to human influence; although time consuming, they are important in determining human impact in our last conserved areas. Additional work near heavily disturbed sites, especially those near habitat planting areas is important to determine whether an increase in the number or density of non-native species has changed through time. Additionally, threatened species within game area borders should also be monitored for signs of potential local extirpation.

ACKKNOWLEDGEMENTS

The first author wishes to gratefully thank Bruce D. Parfitt for the initial idea for this large project and for guidance and training in how to properly collect, press, identify, and mount specimens. Many hours were spent with the second author painstakingly identifying our specimens and learning much about our state flora. Sadly, the second author passed away September 3rd 2009 just as this

FIGURE 8. Inflorescence of Arrow-grass (*Triglochin palustre*). One of the rarer plants at the fen, only five stems were seen during a thorough search. Photo by J.C. Springer.

FIGURE 9. Pitcher-plant (*Sarracenia purpurea*) flower with petals removed to show ovary, and inner surface of umbrella-shaped style. Photo by J.C. Springer.

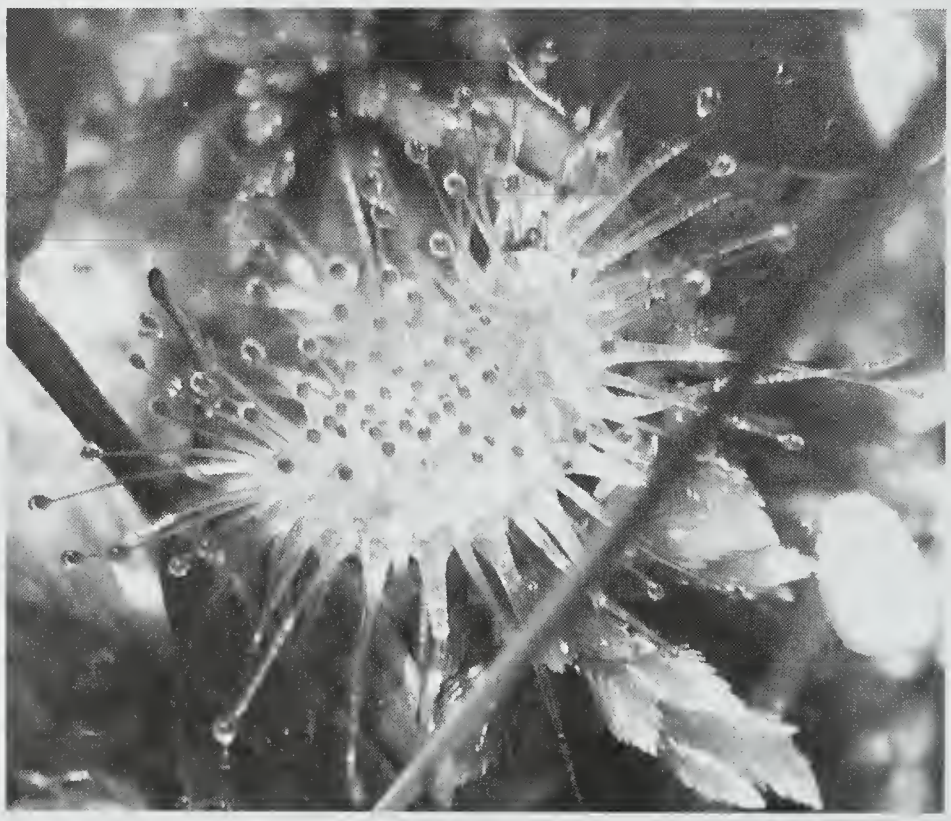

FIGURE 10. Close-up of gland-tipped hairs on leaf of Round-leaved sundew (*Drosera rotundifolia*). Abundant at Sawdel Lake fen, this species was found only rarely elsewhere in the LSGA. Photo by J.C. Springer.

FIGURE 11. Uncommonly found outside of Sawdel Lake fen and other boggy habitats, Tamarack (*Larix laricina*) was a common species at the fen-forest margin with some scattered plants elsewhere on the fen. Photo by J.C. Springer.

FIGURE 12. Flooding #30 is one of many marshy areas created by prevalent dikes in LSGA. Many native aquatic species are found in these rarely visited areas. Photo by J.C. Springer.

manuscript was in its infancy. Bruce instilled a love for floristics and knowledge of plants that persists with the senior author and has lead to graduate studies at Michigan State University. Although the loss of a great friend, birder and botanizer is difficult, the knowledge gained is everlasting and will be passed on.

Additionally, many others helped with collections throughout the years including: Autumn A. Gassel, Erin A. Harris, Jeremy Bishop, Michael Petrucha, Manosha Dasanayaka, Peggy LaRocque, Tony Sorys, Matthew T. Chansler, Elizabeth H. Schultheis, and Mark and Kim Springer. Your patience with my incessant collecting and friendship are much respected.

Any identification errors are the sole responsibility of the primary author. Difficult identifications were completed by E.G. Voss and A.A. Reznicek (especially Cyperaceae and Juncaceae) at the University of Michigan Herbarium, Ann Arbor, Michigan, USA; many thanks for their assistance.

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APPENDIX: CHECKLIST OF VASCULAR PLANTS OF LSGA.

LYCOPHYTES AND MONILOPHYTES

LYCOPODIACEAE

Huperzia lucidula (Michaux) Trevisan; JCS 146 *MICH*, 454.

Lycopodium obscurum L.; JCS 500,629

OPHIOGLOSSACEAE

Botrychium virginianum (L.) Swartz; Rattlesnake Fern; JCS 655.

EQUISETACEAE

Equisetum fluviatile L.; Water Horsetail; JCS 1399.

Equisetum hyemale L.; Field Horsetail; JCS 004, 006; common.

Equisetum sylvaticum L.; Woodland Horsetail; JCS 1389; uncommon in wet border area between fen at Sawdel Lake and deciduous forest.

OSMUNDACEAE

Osmunda claytoniana L.; Interrupted Fern; JCS 130, 568.

Osmunda regalis L.; Royal Fern; JCS 099, 579 *OSH*.

PTERIDACEAE

Adiantum pedatum L.; JCS 164 *MICH*, 368 *MICH*.

ASPLENIACEAE

Asplenium platyneuron (L.) Britton; JCS 128, 687, 1035, 1200.

THELYPTERIDACEAE

Thelypteris palustris Schott; JCS 792.

DRYOPTERIDACEAE

Athyrium filix-femina L.; JCS 340 *MICH*.
Cystopteris bulbifera (L.) Bernh.; JCS 100.
Cystopteris tenuis (Michx.) Desv.; JCS 697, 881 *MICH*.
Dryopteris carthusiana (Vill.) H. P. Fuchs; JCS 162 *MICH*, 864 *MICH*, 974.
Dryopteris intermedia (Muhl. Ex Willd.) A. Gray; JCS 1199.
Onoclea sensibilis L.; Sensitive Fern; JCS 374 *MICH*.
Polystichum acrostichoides (Michx.) Schott; Christmas Fern; JCS 145 *MICH*.

POLYPODIACEAE

Matteuccia struthiopteris (L.) Tod.; Ostrich-fern; JCS 1158, 1176

GYMNOSPERMS

CUPRESSACEAE

Juniperus virginiana L. Red-cedar; JCS 468 *MICH, OSH*; uncommon, large population near 'canoe landing' at Flint River south of Norway Lake road but scattered elsewhere near old homesites.
Juniperus communis L.; Common or Ground Juniper. JCS 203; uncommon
Thuja occidentalis L.; Arbor Vitae or White-cedar. JCS 167; common, especially in wet areas; eastern end of Watz Lake and southern end of Sawdel Lake with largest populations.

PINACEAE

Larix laricina (DuRoi) K. Koch.; Larch or Tamarack; JCS s.n.
**Picea abies* (L.) H.Karst.; Norway Spruce; JCS 183 *MSC*, 452; common near old homesites.
**Picea pungens* Engelmann; Colorado Blue Spruce; JCS 1191; near old homesites.
**Pinus banksiana* Lamb.; Jack Pine; JCS 453 *MICH*; one population at edge of Rood's Lake Road south of Beyers Road in sandy soil.
Pinus resinosa Aiton; Red Pine; JCS 451 *MICH*.
Pinus strobus L.; Eastern White Pine; JCS 515
**Pinus sylvestris* L.; Scotch Pine; JCS 177.
Tsuga canadensis (L.) Carr.; Hemlock; JCS 536.

ANGIOSPERMS

TYPHACEAE

**Typha angustifolia* L.; Narrow-leaved Cat-tail; JCS 782, 196; common to abundant in emergent wetlands, borders of lakes, and man-made floodings.

SPARGANIACEAE (TYPHACEAE)

Sparganium eurycarpum Engelm.; Bur-reed; JCS 185; found and collected only once on dike at eastern border of Long Lake but doubtless elsewhere.

POTAMOGETONACEAE

**Potamogeton crispus* L.; JCS 797; Sawdel Lake.
Potamogeton filiformis Pers. (*Stukenia filiformis* (Pers. Borner); JCS 796; common in Sawdel Lake.
Potamogeton foliosus Raf.; JCS 906 *MICH*, 918; Sawdel Lake.
Potamogeton illinoensis Morong; JCS 281 *MICH*, 795, 914 *MICH MSC*, 932 *MSC*; common in Sawdel Lake.
Potamogeton natans L.; JCS 279, 826, 915 *MICH*, 988 *MICH*; flooding #13 and Sawdel Lake.
Potamogeton zosteriformis Fernald; JCS 801, 917, 994; flooding #13 and Sawdel Lake.

JUNCAGINACEAE

Triglochin palustris L.; Arrow-grass; JCS 1404; uncommon on fen at Sawdel Lake.

ALISMATACEAE

Alisma plantago-aquatica L.; Water-plantain; JCS 332; occasional in wet areas.

Sagittaria latifolia Willd; Wapato or Duck Potato; JCS 262 *MICH*, 907 *MICH, MSC*, 977; uncommon.

HYDROCHARITACEAE

Elodea canadensis Michaux; Waterweed, Elodea; JCS 631,798; collected only at Sawdel Lake boat launch.

NAJADACEAE (HYDROCHARITACEAE)

Najas flexilis (Willd.) Rostk. & Schmidt; Naiad; JCS 800, 905 *MICH*; collected only in Sawdel Lake.

POACEAE

**Agropyron repens* (L.) Beauv (*Elymus repens* (L.) Gould); Quack Grass; JCS 243; disturbed areas, especially parking lots.

**Agrostis gigantea* Roth.; Redtop; JCS 831, 1134.

Agrostis perennans (Walter) Tuck.; Autumn or Upland Bent; JCS 975; uncommon.

**Agrostis tenuis* Sibth. (*Agrostis capillaris* L.); Colonial Bent or Rhode Island Bent; JCS 945; one small population collected at corner post of game area; possibly associated with yard clippings.

Andropogon gerardii Vitman; Big Bluestem or Turkey foot; JCS 319 *MICH*; seeming to last only as a waif after planting by DNR for prairie plantings, some establishment possible.

Aristida basiramea Vasey; JCS 1165; collected in 'desert' area of game area south of Sno-Den trail.

Brachyelytrum erectum (Schreb.) P. Beauv.; JCS 149,1041; rich, deciduous woods.

**Bromus inermis* Leysser; Smooth Brome; JCS 242, 254, 313, 380; trailsides, roadsides, parking lots, and other disturbed areas.

**Bromus tectorum* L.; Downy Chess; JCS 675 *MICH*; disturbed areas.

Calamogrostis canadensis (Michaux) Beauv.; JCS 995; common in more wet areas.

Calamogrostis stricta (Timm) Koeler; JCS 929; eastern shore of Watz Lake.

Cenchrus longispinus (Hacker) Fern.; JCS 1152; sandy areas and some disturbed ground.

Cinna arundinacea L.; Wood Reedgrass; JCS 976, 985; wet areas.

**Dactylis glomerata* L.; Orchard Grass; JCS 123 *MICH*; shore of unnamed flooding north of Vernor Road; unknown from other areas.

**Digitaria sanguinalis* (L.) Scop.; Crab Grass; JCS 964 *MICH*; uncommon in disturbed areas; especially parking areas.

**Echinochloa crusgalli* (L.) P. Beauv.; Barnyard Grass; JCS 921; disturbed areas.

Echinochloa muricata (P. Beauv.) Fern.; JCS 320 *MICH*, 1192; wet roadsides and other damp places.

Elymus villosus Willd.; Wild-rye; JCS 984; wet areas.

Elymus riparius Wieg; JCS 400; Duperow Lake parking area.

Eragrostis pectinacea (Michaux) Nees; Love Grass; JCS 852, 920, 965 *MICH*; some disturbed areas and associated with fen at Sawdel Lake.

**Eragrostis poaeoides* R. & S. (*Eragrostris minor* Host); JCS 1164; disturbed areas.

**Festuca arundinacea* Schreb. (*Schedonorus arundinaceus* (Schreb.) Dumort.); Tall Fescue; JCS 760 *MICH*; disturbed areas.

Festuca obtusa Biehler (*Festuca subverticillata* (Pers.) Alexeev); JCS 717, 858; rich, deciduous forest.

Glyceria striata (Lam.) Hitchc.; Fowl Manna Grass; JCS 753, 981, 1391; standing water and very wet soils.

Hystrix patula Moench (*Elymus hystrix* L.) Bottlebrush Grass; JCS 153, 744, 399 *MICH*; common in most deciduous forests.

Leersia oryzoides (L.) Sw.; Cut Grass; JCS 912; collected only at fen of Sawdel Lake, abundant there.

Leptoloma cognatum (Schultes) Chase (*Digitaria cognata* (Schult.) Pilg.) Fall Witch Grass; JCS 956 *MICH*; open meadows with sandy soil.

**Lolium perenne* L.; Ryegrass; JCS 401; common in habitat plantings or food plots maintained by MDNR.

Milium effusum L.; JCS 626, 740, 876; deciduous forests and some trailsides.

Muhlenbergia mexicana (L.) Trin; Muhly; JCS 950, 1004; disturbed parking areas and wet areas near Long Lake.

Oryzopsis asperifolia Michaux; JCS 538; deciduous forest.

Panicum commonsianum Ashe (*Dichanthelium commonsianum* (Ashe) Freckmann, but *Panicum addisonii* may have name priority); JCS 703; sandy soil in deciduous forest.

Panicum implicatum Britton (*Dichanthelium implicatum* (Scribn.) Kerguelen); JCS 963 *MICH*; collected only in meadow near flooding #30 in eastern game area.

Panicum latifolium L. (*Dichanthelium latifolium* (L.) Harvill); JCS 870; deciduous forest with gravelly soil.

Panicum virgatum L. Switch Grass; JCS 979,1159; persisting only in prairie habitat plantings.

**Phalaris arundinacea* L.; Reed Canary Grass; JCS 228, 712 *MICH*, 1133; habitat plantings and some natural meadows.

**Phleum pratense* L.; Timothy; JCS 124 *MICH*, 244 *MICH*, 339, 1132; common, especially in disturbed areas and habitat plantings.

**Phragmites australis* (Cav.) Steudel; Reed; JCS 256; very localized, uncommon in roadside wet places.

**Poa bulbosa* L.; JCS 1121; seen and collected only once at Oxbow Campground on Flint River.

**Poa compressa* L.; Canada Bluegrass; JCS 323; roadsides and disturbed areas.

**Poa pratensis* L.; Kentucky Bluegrass; JCS 620 *MICH*, 685; disturbed areas, particularly parking areas where discarded yard waste present.

Schizachne purpurascens (Torrey) Swallen; False Melic; JCS 539; uncommon.

**Setaria faberi* Herrm.; Giant Foxtail; JCS 957, 961; meadows and prairies maintained grassy areas.

**Setaria glauca* (L.) Beauv. (*Setaria pumila* (Poir.) Roem. & Schult.); Yellow Foxtail; JCS 325 *MICH*, 404; roadsides and parking areas.

**Sorghum bicolor* (L.) Moench; Sorghum; JCS 1206; barely persisting in habitat plantings and food plots.

Trisetum melicoides (Michaux) Scribner (*Graphephorum melicoides* (Michx.) Desv.); JCS 699 *MICH*.

**Zea mays* L. Maize; JCS 1196; persisting for short periods after planting for food plots.

Zizania aquatica L. Southern Wild Rice; JCS 911 *MICH, MSC*; common to abundant in shallow flowing water associated with Sawdel Lake. **Threatened**.

CYPERACEAE

Carex arctata Boott; JCS 514 *MICH*; wet shore of Sawdel Lake.

Carex bebbii (L. H. Bailey) Fernald; JCS 908,1013; wet shore of Long and Sawdel lakes.

Carex blanda Dewey; JCS 555 *MICH*, 592.

Carex comosa Boott; JCS 106, 930 *MICH*; occasional along lakeshores and stream banks.

Carex cristatella Britton; JCS 742; wet areas in deciduous forests.

Carex deweyana Schwein.; JCS 571 *MICH*.

Carex flava L. Yellow sedge; JCS 1393

Carex gracillima Schwein.; JCS 627; common in deciduous forests.

Carex granularis Willd.; JCS 842, 1010; shores and wet areas near lakes.

Carex interior L. H. Bailey; JCS 577, 1392; common in bog on north shore of Cedar Lake.

Carex intumescens Rudge; JCS 623 *MICH*, 680 *MICH*; wet depressions in forests.

Carex leptalea Wahlenb.; JCS 790; abundant along shores of Sawdel Lake.

Carex leptonervia Fernald (Fernald); JCS 043 *MICH*.

Carex lupulina Willd.; JCS 378 *MICH*.

Carex normalis Mack.; JCS 850.

Carex pensylvanica Lam.; JCS 511 *MICH*, 562; deciduous forest, fairly common.

Carex radiata (Wahlenb.) Small; JCS 061 *MICH*.

Carex rosea Willd.; JCS 570, 594, 676; sandy disturbed trailside near Cedar Lake and in deciduous forests.
Carex sparganioides Willd.; JCS 694.
Carex sterilis Willd.; JCS 793; common near Sawdel Lake fen.
Carex stipata Willd.; JCS 624, 678 *MICH*; common in deciduous forests.
Carex viridula Michaux; JCS 1014; wet areas near Long Lake.
Carex vulpinoidea Michaux; JCS 105, 131 *MICH*, 232.
Carex prairea Dewey; JCS 578; seen and collected only once at bog on shore of Cedar Lake.
Cladium mariscoides (Muhl.) Torrey Twig-rush; JCS 883, 1394; scattered on Sawdel Lake fen.
Cyperus engelmannii Steud. Nut-grass or Umbrella Sedge; JCS 274, 997; floodings and wet areas.
Cyperus filiculmis Vahl. (*Cyperus lupulinus* (Spreng.) Marcks); JCS 958 *MICH*.
Cyperus rivularis Kunth (*Cyperus bipartitus* Torr.); JCS 273.
Dulichium arundinaceum (L.) Britton; JCS 992 *MICH*; seen and collected once at flooding #13.
Eleocharis erythropoda Steud. Spike-rush: JCS 221 *MICH*, 827, 843, 909 *MICH*, 941; common to abundant in wet areas.
Eleocharis intermedia Schult.; JCS 936, 1012; scattered near shores of Long and Watz lakes.
Eleocharis olivacea Torrey (*Eleocharis flavescens* (Poir.) Urb.); JCS 348; shores of Cedar Lake.
Eleocharis smallii Britton (*Eleocharis palustris* (L. Roem. & Schult.); JCS 990; collected at flooding #13.
Eriophorum viridi-carinatum (Engelm.) Fernald; JCS 1395
Scirpus acutus Bigelow (*Schoenoplectus acutus* (Bigelow) A. Love & D. Love); Hardstem Bulrush; JCS 264 *MICH*, 832, 1397; wet areas around shores of lakes.
Scirpus americanus Pers.; (*Schoenoplectus pungens* (Vahl) Palla); Threesquare; JCS 841.
Scirpus atrovirens Willd.; JCS 104 *OSH*, 233 *MICH*, 840; common at shores of lakes and floodings.
Scirpus cyperinus (L.) Kunth; Wood-grass; JCS 259 *MICH, OSH*, 761 *MICH*; uncommon.
Scirpus pendulus Muhl.; JCS 241 *MICH*, 711, 758, 1007, 1009; common in wet areas.
Scirpus validus Vahl. (*Schoenoplectus tabernaemontani* (C. C. Gmel.) Palla); Softstem Bulrush; JCS 160, 766, 833; fairly common in wet areas.

ARACEAE

Arisaema triphyllum (L.) Schott; Jack-in-the-Pulpit; JCS 047 *MSC*; common in deciduous forests.
Symplocarpus foetidus (L.) W. P. C. Barton; Skunk-cabbage; JCS 455,457; common to abundant in riparian habitats along Flint River.

LEMNACEAE (ARACEAE)

Lemna minor L.; Duckweed; JCS 402; abundant, especially in more stagnant water.
Lemna trisulca L.; Star Duckweed; JCS 649; seen and collected once at roadside pond near Long Lake.
Spirodela polyrhiza (L.) Schleiden Greater Duckweed; JCS 768; uncommon.

COMMELINACEAE

**Commelina communis* L.; Day-flower; JCS 360 *MICH*, 815 *MICH*; small population apparently introduced via yard waste.

PONTEDERIACEAE

Pontederia cordata L.; Pickerel-weed; JCS 263; large population at northwestern edge of Long Lake.

JUNCACEAE

Juncus articulatus L.; JCS 213c, 756, 757, 942.
Juncus brachycephalus (Engelm.) Buchenau; JCS 1015.
Juncus dudleyi Wiegand; JCS 234, 710, 828, 829.
Juncus nodosus L.; JCS 213, 275, 834, 1011.
Juncus tenuis Willd.; Path Rush; JCS 117 *OSH*, 767, 978; common in wet soils.

Luzula acuminata Raf.; Wood Rush; JCS 041 *MICH*, 497.
Luzula multiflora (Ehrh.) Lej.; JCS 591, 677; uncommon in forests and wet areas.

LILIACEAE

Allium tricoccum Aiton (Alliaceae); Wild Leek; JCS 1172; uncommon in deciduous forests.
**Asparagus officinalis* L. (Asparagaceae); Asparagus; JCS 324 *MICH*; scattered along some roadsides and at some old homesites.
Erythronium americanum Ker.; Trout Lily or Dogtooth-violet; JCS 459 *OSH*; common.
**Hemerocallis fulva* (L.) L. (Hemerocallidaceae); Orange Day-lily; JCS 180; common to abundant, especially at old homesites and parking lots where yard waste is disposed.
Lilium michiganense Farw.; Michigan Lily; JCS 152 *MICH*, 770; wet areas and common along some streams.
Maianthemum canadense Desf.; (Convallariaceae); Canada Mayflower or False Lily-of-the-valley; JCS 032, 365; abundant.
Medeola virginiana L. (Convallariaceae); Indian Cucumber Root; JCS 690; uncommon.
**Narcissus poeticus* L.; (Amaryllidaceae); Poet's Narcissus; JCS 513; uncommon but sometimes common at old homesites.
Polygonatum pubescens (Willd.) Pursh; (Convallariaceae); Soloman-seal; JCS 044, 693; scattered and locally common in deciduous forests.
Smilacina racemosa (L.) Desf. (*Maianthemum racemosum* (L.) Link); False Spikenard; JCS 682 *MICH*, 716; occasional.
Smilacina stellata (L.) Desf.; (*Maianthemum stellatum* (L.) Link); Starry false Solomon-seal; JCS 056 *MSC*, 645 *OSH*; uncommon to rare.
Smilax lasioneura Hooker; (Smilacaceae); Carrion-flower; JCS 1032.
Smilax tamnoides L. (Smilacaceae); (*Smilax hispida* Raf.); Bristly Greenbrier; JCS 1033 *MICH*, 1037.
Tofieldia glutinosa (Michaux) Pers.; (Melanthiaceae); (*Triantha glutinosa* (Michx.) Baker; Sticky False Asphodel; JCS 432 *MICH*, 890, 1396; common on fen at Sawdel Lake.
Trillium cernuum L. (Trilliaceae); Nodding Trillium; JCS 564; one population of about seven individuals on Beyers Road roadside.
Trillium grandiflorum (Michaux) Salisb. (Trilliaceae); Common Trillium; JCS 020 *MSC*; common.
Uvularia grandifolia Sm. (Convallariaceae); Bellwort; JCS 054 *MSC*; seen and collected once on roadside of Five Lakes Road.
Uvularia sessilifolia L. (Convallariaceae); Merrybells; JCS 506.
**Yucca filamentosa* L. (Agavaceae); Yucca or Adam's-needle; JCS 1052; no fruiting individuals found in this population of six individuals at extreme northeastern portion of game area.

AMARYLLIDACEAE (HYPOXIDACEAE)

Hypoxis hirsuta (L.) Coville; Star-grass; JCS 1382; common on fen at Sawdel Lake.

DIOSCOREACEAE

Dioscorea villosa L.; Wild Yam; JCS 175 *MICH*, 227 *MICH*, 684 *MICH*; common in some wet areas.

IRIDACEAE

Iris virginica L.; Southern Blue Flag; JCS 249; wet areas.

ORCHIDACEAE

Calopogon tuberosus (L.) Britton, Sterns & Poggenb.; Grass Pink; JCS 1380; abundant on fen at Sawdel Lake.
Corallorhiza maculata Raf.; Spotted Coral-root; JCS 1055, 1171, 1180; uncommon.
Cypripedium calceolus L.; Yellow Lady-slipper; JCS 1383.
Cypripedium reginae Walter; Showy Lady-slipper; JCS 772; extremely common in wet areas around Sawdel Lake.
Epipactis helleborine (L.) Crantz; Helleborine; JCS 746, 857; fairly common in many deciduous forests.
Pogonia ophioglossoides (L.) Ker Gawl.; Rose Pogonia; JCS 1381; uncommon on fen at Sawdel Lake.

SALICACEAE

Populus deltoides Marsh.; Cottonwood; JCS 637; scattered throughout wet areas.
Populus grandidentata Michaux; Largetooth or Bigtooth Aspen; JCS 632 *OSH*, 658 *OSH*; forming small groves in more sandy soils.
Populus tremuloides Michaux; Quaking Aspen; JCS 1122, 1163; fairly common, especially along edges of forests and some managed fields.
**Salix alba* L.; White Willow; JCS 546, uncommon.
Salix bebbiana Sarg.; Beaked or Bebb's Willow; JCS 220 *MICH*, 476, 481, 530 *MICH*, 582.
Salix discolor Muhl.; Pussy Willow; JCS 461 *MICH*, 470, 477 *MICH*, 482 *MICH*, 483, 512, 542.
Salix eriocephiala Michaux; JCS 467a, 467b, 471, 474, 475, 484 *MICH*, 489, 495, 558.
Salix exigua Nutt.; Sandbar Willow; JCS 182 *MSC*, 257 *MICH*, 486, 509, 559, 560, 576, 838.
Salix humilis Marsh.; Upland or Prairie Willow; JCS 581, 585.
Salix myricoides Muhl.; Blueleaf Willow; JCS 466a.
Salix nigra Marsh.; Black Willow; JCS 586.
Salix petiolaris J.E. Smith; Slender or Meadow Willow; JCS 066, 472, 485.
**Salix purpurea* L.; Basket or Purple-osier Willow; JCS 490.
Salix sericea Marsh.; Silky Willow; JCS 465 *MICH*, 466b, 469, 473, 543.
Salix ×*rubens* Schrank; JCS 595; one population found on Cedar Lake Road south of King's Mill Road. Hybrid between *S. alba* L. and *S. fragilis* L., although *S. fragilis* was not found nearby.

JUGLANDACEAE

Carya glabra (Miller) Sweet; Pignut Hickory; JCS 1162; one large tree in open meadow west of Long Lake.
Carya ovata (Miller) K. Koch; Shellbark or Shagbark Hickory; JCS 311, 657 *MICH*.
Juglans nigra L.; Black Walnut; JCS 330 *MSC*; seemingly planted along roadside near "Dog Trial" area west of Five Lakes Road.

BETULACEAE

Alnus rugosa (Duroi) Sprengel; Speckled Alder; JCS 258 *MICH*.
Betula papyrifera Marsh; Paper, White, or Canoe Birch; JCS 209 *MSC*.
Betula pumila L.; Bog or Dwarf Birch; JCS 788; fen on southern shore of Sawdel Lake.
Carpinus caroliniana Walter; Hornbeam or Blue-beech; JCS 154 *MICH*.
Ostrya virginiana (Miller) K. Koch; Ironwood or Hop-hornbeam; JCS 137 *MSC*, 151.

FAGACEAE

Fagus grandifolia Ehrh.; Beech; JCS 1061.
Quercus alba L.; White Oak; JCS 376 *MICH, OSH*, 381, 385.
Quercus bicolor Willd.; Swamp White Oak; JCS 1178.
Quercus macrocarpa Michx.; Bur Oak; JCS 383 *MICH, OSH*, 1170.
Quercus palustris Moench; Pin Oak; JCS 363 *MICH*.
Quercus rubra L.; Red Oak; JCS 1062.
Quercus velutina Lam.; Black Oak; JCS 382.

ULMACEAE

Celtis occidentalis L.; (Cannabaceae) Hackberry; JCS 719 *MICH*, 1185.
Ulmus americana L.; American or White Elm; JCS 016 *MICH*, 548.

MORACEAE

**Morus alba* L.; Russian or White Mulberry; JCS 143 *OSH, MSC*.

URTICACEAE

Boehmeria cylindrica (L.) Sw.; False Nettle; JCS 349, 354 *MICH*.
Pilea fontana (Lunell) Rydberg; Clearweed or Richweed; JCS 910; growing in old stumps within Sawdel Lake.
Urtica dioica L.; Stinging Nettle; JCS 239, 240; scattered colonies in some deciduous forests.

SANTALACEAE

Comandra umbellata (L.) Nutt.; Bastard-toadflax or Star-toadflax; JCS 065, 613; sandy hills east of Cedar Lake.

ARISTOLOCHIACEAE

Asarum canadense L.; Wild-ginger; JCS 494; fairly common.

POLYGONACEAE

**Fagopyrum esculentum* Moench; Buckwheat; JCS 1154; persisting only for short periods after introduction in food plots.

Polygonum amphibium L. (*Persicaria amphibia*; Water Smartweed; JCS 206, 277 *OSH*, 824.

**Polygonum convolvulus* L. (*Fallopia convolvulus* (L.) A. Love); Black-bindweed or False Buckwheat; JCS 216 *MICH*, 818, 973.

**Polygonum cuspidatum* Sieb. & Zucc. (*Fallopia japonica* (Houtt.) Ronse Decr.); Japanese Knotweed; JCS 287; one large population near intersection of Vernor and Five Lakes roads.

Polygonum lapathifolium L. (*Persicaria lapathifolia* (L.) Delarbre); Willow-weed or Nodding Smartweed; JCS 276a

**Polygonum persicaria* L. (*Persicaria maculosa* Gray); Heart's-ease or Lady's-thumb; JCS 276b, 851

Polygonum punctatum Ell. (*Persicaria punctata* (Elliot) Small); Smartweed or Knotweed; JCS 904, 923

Polygonum sagittatum L. (*Persicaria sagittata* (L.) H. Gross); Tear-thumb; JCS 986

Polygonum scandens L. (*Fallopia scandens* (L.) Holub); False Buckwheat or Black-bindweed; JCS 1048

Polygonum tenue Michaux; Smartweed or Knotweed; JCS 336

Polygonum virginianum L. (*Persicaria virginiana* (L.) Gaertn.); Jumpseed; JCS 392 *MICH*, 983

**Rumex acetosella* L.; Sheep or Red Sorrel; JCS 597

**Rumex crispus* L.; Curly or Sour Dock; JCS 086 *OSH, MSC*, 724.

Rumex verticillatus L.; Water Dock; JCS 1044

AMARANTHACEAE

Amaranthus albus L.; Pigweed or Amaranth; JCS 1201; seen and collected once at the "desert" south of Sno-den trail.

Chenopodium album L.; Lambs-quarters or Pigweed; JCS 317.

Chenopodium hybridum L. (*Chenopodium simplex* (Torr.) Raf.); Goosefoot; JCS 169 *MICH*, 396.

NYCTAGINACEAE

* *Mirabilis hirsuta* (Pursh) Macm. (*Mirabilis albida* (Walter) Heimerl); Umbrellawort; JCS 867 *MICH*.

PHYTOLACCACEAE

Phytolacca americana L.; Pokeweed or Poke; JCS 1166; seen and collected once in hedgerows in prairie plantings south of the "desert" at southern end of Sno-den trail.

MOLLUGINACEAE

**Mollugo verticillata* L.; Carpetweed; JCS 1169; seen and collected once at parking area and weedy areas in prairie plantings south of the "desert" at southern end of Sno-den trail.

PORTULACACEAE (MONTIACEAE)

Claytonia virginica L.; Spring-beauty; JCS 462; extremely common in deciduous forests.

CARYOPHYLLACEAE

**Arenaria serpyllifolia* L.; Sandwort; JCS 644.

**Cerastium fontanum* Baumg.; Mouse-ear Chickweed; JCS 531, 532

**Dianthus armeria* L.; Deptford Pink; JCS 140, 722.; open areas.

**Saponaria officinalis* L.; Bouncing Bet or Soapwort; JCS 174.

**Silene pratensis* (Raf.) Godron & Gren.; (*Silene latifolia* Poir.); White Cockle or White Campion; JCS 063 *MICH*, 616.

**Stellaria graminea* L.; Chickweed; JCS 709 *MICH*; along trail in deciduous woods.

**Stellaria media* (L.) Vill.; JCS 519.; open mowed area near old homesite.

CERATOPHYLLACEAE

Ceratophyllum demersum L.; Coonwort; JCS 799, 919, 938; extremely common in some lakes, sometimes forming very large mats.

NYMPHAEACEAE

Brasenia schreberi J.F. Gmelin (Cabombaceae); Water-shield; JCS 278.

Nuphar variegata Durand; Pond-lily, Cow-lily, or Spatterdock; JCS 633.

Nymphaea odorata Aiton; Water-lily; JCS 282.

RANUNCULACEAE

Actaea pachypoda Elliott; White Baneberry or Doll's-eyes; JCS 040 *MSC*, 692, 721, 743; fairly common in deciduous forests.

Actaea rubra (Aiton) Willd.; Red Baneberry; JCS 291, 567, 952 *MICH*; scattered and in similar habitats as *Actaea pachypoda* but in some coniferous areas.

Anemone quinquefolia L.; Wood Anemone; JCS 025 *MICH*, 055, 491; common in some wet areas.

Anemone virginiana L.; Thimbleweed; JCS 737 *MICH*, 859; fairly common.

Aquilegia canadensis L.; Wild Columbine; JCS 075 *MSC*; uncommon.

Caltha palustris L. Marsh-marigold or Cowslip; JCS 011 *MSC*; common in wet, mucky soils, especially along streamsides.

Clematis virginiana L.; Virgin's Bower, Clematis, or Woodbine; JCS *s.n.*; one large plant at canoe landing area on Flint River on Norway Lake Road.

Coptis trifolia (L.) Salisb; Goldthread; JCS 504; uncommon.

Hepatica americana (DC.) Ker; Round-leaved Hepatica; JCS 007 *MSC, OSH*; abundant in most deciduous forests.

Hydrastis canadensis L.; Goldenseal; JCS1179; **Threatened**.

Ranunculus abortivus L.; Small-flowered Buttercup; JCS 517.

**Ranunculus acris* L.; Tall or Common Buttercup; JCS 830.

Ranunculus hispidus Michx.; Swamp or Hispid Buttercup; JCS 621 *OSH*, 706; fairly common.

Ranunculus longirostis Godron (*Ranunculus aquatilis*); White Water Crowfoot; JCS 648, 769; roadside flooding and Sawdel Lake.

Ranunculus recurvatus Poiret; Hooked Crowfoot; JCS 048, 561.

Thalictrum dasycarpum Fisch. & Ave-Lall; Purple Meadow-rue; JCS 292, 780, 1387.

Thalictrum dioicum L.; Early Meadow-rue; JCS 026, 696, 1042.

BERBERIDACEAE

**Berberis thunbergii* D.C.; Japanese Barberry; JCS 265 *OSH*; fairly common, especially in more disturbed forested areas and roadsides.

Caulophyllum thalictroides (L.) Michaux; Blue Cohosh; JCS 569, 869 *MICH*.

Podophyllum peltatum L.; May-apple or Mandrake; JCS 034.

MENISPERMACEAE

Menispermum canadense L.; Moonseed; JCS 157; locally common but no flowering specimens observed.

MAGNOLIACEAE

Liriodendron tulipifera L.; Tulip-tree, Tulip-poplar, or Yellow-poplar; JCS 853 *MICH, OSH*; small population of 15—20 individuals of various ages and sizes near Twin Lake.

LAURACEAE

Lindera benzoin (L.) Blume; Spicebush; JCS 884 *MICH*.

Sassafras albidum (Nutt.) Nees; Sassafras; JCS 166, 507, 949; fairly common, especially in sandy areas and along trails and forest edges; common along trail leading to Watz Lake.

PAPAVERACEAE

**Papaver rhoeas* L.; Corn, Field, or Flanders Poppy; JCS 115; numerous individuals in prairie planting maintained by MDNR.

Sanguinaria canadensis L.; Bloodroot; 460.

BRASSICACEAE

**Alliaria petiolata* (Beib.) Cavara & Grande; Garlic Mustard; JCS 027 *MICH*; one large population near old Vernor homestead site on Vernor Road; small localized populations at some parking areas but thankfully not found elsewhere.

Arabis canadensis L. (*Boechera canadensis* (L.) Al-Shehbaz); Sickle-pod; JCS 745 *MICH*.

Arabis glabra (L.) Bernh. (*Turritis glabra* L.); Tower Mustard; JCS 674 *MICH*.

Arabis hirsuta (L.) Scop.; Rock Cress; JCS 713.

**Barbarea vulgaris* W. T. Aiton; Yellow Rocket; JCS 024, 200 *MICH*, 611; fairly common, especially in more disturbed areas and habitat plantings.

**Berteroa incana* (L.) DC.; Hoary Alyssum; JCS 087 *MSC*, 253 *MSC*, 666 *MICH*; common.

**Camelina microcarpa* DC.; Littlepod False Flax; JCS 609,673; common in meadow adjacent to Dog trial area; apparently planted by MDNR.

**Capsella bursa-pastoris* (L.) Medicus; Shepherd's-purse; JCS 039 *OSH*, 544.

Cardamine bulbosa (Muhl.) Britton, Sterns & Poggenb.; Spring Cress; JCS 625; fairly common in wet woods.

Cardamine douglassii Britton; Pink Spring Cress; JCS 458.

**Erysimum capitatum* (Douglas) Greene; Western Wallflower; JCS 608; common in prairie area planted and mainted by MDNR.

**Hesperis matronalis* L.; Dame's Rocket; JCS 606 *MICH*; common in prairie area planted and maintained by MDNR.

**Lepidium campestre* (L.) W. T. Aiton; Pepper-grass; JCS 610.

**Sisymbrium altissimum* L.; Tumble Mustard; JCS 141, 315.

**Sisymbrium officinale* (L.) Scop.; Hedge Mustard; JCS 817.-

**Thlaspi arvense* L.; Penny Cress; JCS 171 *MICH*.

SARRACENIACEAE

Sarracenia purpurea L.; Pitcher-plant; JCS 344, 882; common to abundant at Cedar Lake bog and Sawdel Lake fen.

DROSERACEAE

Drosera rotundifolia L.; Round-leaved Sundew; JCS 1400; common on *Sphagnum sp*. mat at Sawdel Lake.

CRASSULACEAE

**Sedum telephium* L.; Live-forever; JCS 1049; localized, near old homesites.

PENTHORACEAE

Penthorum sedoides L.; Ditch Stonecrop; JCS 217 *MICH*, 333; locally common on dike at Long Lake.

PARNASSIACEAE

Parnassia glauca Raf.; Grass-of-Parnassus; JCS 433, 886; common on Sawdel Lake fen.

SAXIFRAGACEAE

Mitella diphylla L.; Bishop's-cap; JCS 031 *MICH*, 534.

Saxifraga pensylvanica L.; Swamp Saxifrage; JCS 037; locally common at wet, swampy area at eastern end of Watz Lake.

GROSSULARIACEAE

Ribes americanum Miller; Wild Black Currant; JCS 252, 520, 541.

Ribes cynosbati L.; Wild or Prickly Gooseberry; JCS 550.

Ribes triste Pailas; Swamp Red Currant; JCS 525; one small population at entrance to trail leading to Sawdel Lake from Norway Lake Road.

HAMAMELIDACEAE

Hamamelis virginiana L.; Witch-hazel; JCS 403 *MICH*, 409, 1060.

PLATANACEAE

Platanus occidentalis L. Sycamore; JCS 1058, 1184; scattered along Flint River floodplain.

ROSACEAE

Agrimonia gyrosepala Wallr.; Agrimony; JCS 147.

Agrimonia pubescens Wallr.; Agrimony; JCS 290 *MICH*, 855.

Amelanchier arborea (F. Michx.) Fern; Serviceberry, Shadbush, Shadblow, Juneberry, or Sugarplum; JCS 014, 479; fairly common in deciduous forests.
Amelanchier interior E. L. Nielsen; Serviceberry, Shadbush, Shadblow, Juneberry, or Sugarplum; JCS 132.
Amelanchier laevis Wiegand; Serviceberry, Shadbush, Shadblow, Juneberry, or Sugarplum: JCS 129, 463 *OSH*.
Aronia prunifolia (Marsh.) Rehder; Chokeberry; JCS 588, 927; fairly common in wet areas surrounding Cedar and Watz lakes.
Crataegus macrosperma Ashe; Hawthorn or Thornapple; JCS 059, 598, 1054 *MICH*.
Crataegus pruinosa (H. L. Wendl.) K. Koch; Hawthorn or Thornapple; JCS 589.
Fragaria virginiana Mill.; Wild Strawberry; JCS 518; fairly common in many open meadows and in some sandy areas.
Geum aleppicum Jacq.; Avens; JCS 656; occasional in wet areas.
Geum canadense Jacq.; Avens; JCS 101, 238 *OSH*, 707 *MICH*.
Geum laciniatum Murray; Avens; JCS 1129
Geum vernum (Raf.) T & G; Avens; JCS 545
Malus coronaria (L.) Miller; Wild, American, or Sweet Crab; JCS 1167.
Malus ioensis (Wood); Britton Prairie Crab; JCS 266 *MICH*.
**Malus pumila* Miller; Apple; JCS 318 *MICH*, 526, 527, 529; common near old homesites.
Physocarpus opulifolius (L.) Maxim; Ninebark; JCS 161, 775, 1385.
**Potentilla argentea* L.; Silvery Cinquefoil; JCS 667 *MICH*; common in meadow areas surrounding Long Lake.
Potentilla canadensis L.; JCS 522, 1027, 1124; found in sandy areas and most likely to be included with *P. simplex* below.
Potentilla fruticosa L.; Shrubby Cinquefoil; JCS 434, 776.
Potentilla norvegica L.; Rough Cinquefoil; JCS 836, 215; fairly common, especially in some disturbed sites.
Potentilla simplex Michaux; Common or Old-field Cinquefoil; JCS 593, 619, 660 *MICH*, 046.
**Potentilla recta* L.; Rough-fruited Cinquefoil; JCS 125 *MSC*.
Prunus pensylvanica L.f.; Pin or Fire Cherry; JCS 168 *MICH*, 508, 528; common.
Prunus virginiana L.; Choke Cherry; JCS 057 *OSH*, 225 *MICH*, 599 *OSH*, 762 *MICH*; common.
**Pyrus communis* L.; Pear; JCS 575; collected near old homesite.
Rosa blanda Aiton; Wild Rose; JCS 754; one plant east of Five Lakes Road southwest of intersection with Vernor Road.
Rosa carolina L.; Pasture Rose; JCS 223; dike at Long Lake.
**Rosa cinnamomea* L.; Cinnamon Rose; JCS 1029.
**Rosa multiflora* Murray; Multiflora or Japanese Rose; JCS 102, 231 *MICH*, 397.
Rosa palustris Marsh; Swamp Rose; JCS 583; boggy area at Cedar Lake.
Rubus allegheniensis Porter; Common Blackberry; JCS 720, 1189, 1157.
Rubus flagellaris Willd.; Northern Dewberry; JCS 1190.
Rubus occidentalis L.; Black Raspberry; JCS 641, 751, 072.
Rubus pubescens Raf.; Dwarf Raspberry; JCS 501, 050 *MSC*, 098 *MICH*.
Spiraea alba Duroi; Meadowsweet; JCS 193 *MICH*, 350, 993, 837; fairly common in wet areas.

FABACEAE

Amphicarpaea bracteata (L.) Fern.; Hog-peanut; JCS 954
Apios americana Medicus; Groundnut, Wild-bean, or Indian-potato; JCS 925, 1183.
Astragalus canadensis L.; Canada Milk-vetch; JCS 269 *MSC*; seen and collected only once from an island within Long Lake; others possible. **Threatened**.
**Coronilla varia* L.; Crown-vetch; JCS 1135; collected from Fish Lake roadside after recent construction by Michigan Department of Transportation.
Desmodium canadense (L.) DC.; Beggars-tick or Tick-trefoil; JCS 270 *MSC*, 822 *MICH*, 953.
Desmodium glutinosum (Willd.) Wood; Beggars-tick or Tick-trefoil; JCS 135 *MICH*, 327.
Desmodium obtusum (Willd.) DC.; Beggars-tick or Tick-trefoil; JCS 874, 944I *MSC*.

Lathyrus palustris L.; Marsh Pea; JCS 779, 1136; scattered in wet areas.
**Lathyrus sylvestris* L.; Perennial or Everlasting Pea; JCS 260, 748 *MICH*.
Lespedeza capitata Michaux; Bush-clover; JCS 946.
**Lotus corniculata* L.; Birdfoot Trefoil; JCS 107; common in highly disturbed areas.
Lupinus perennis L.; Wild Lupine; JCS 1207; seemingly planted with other prairie species but persisting and spreading.
**Medicago lupulina* L.; Black Medick; JCS 650 *OSH*; abundant in habitat plantings.
**Medicago sativa* L.; Alfalfa; JCS 862; abundant in habitat plantings.
**Melilotus alba* Medicus; White Sweet-clover; JCS 120; common in disturbed areas.
**Melilotus officinalis* (L.) Pall.; Yellow Sweet-clover; JCS 089 *MICH*; common in disturbed areas.
**Robinia pseudoacacia* L.; Black Locust; JCS 846 *MICH*; one population found south of King's Mill Road east of trail leading to Twin Lake.
**Trifolium hybridum* L.; Alsike Clover; JCS 661.
**Trifolium pretense* L.; JCS Red Clover; JCS 662.
Vicia americana Willd.; American Vetch; JCS 634 *OSH*, 714; occasional in some wet areas.
**Vicia tetrasperma* (L.) Schreber; Sparrow Vetch; JCS 671 *MICH*.
**Vicia villosa* Roth.; Hairy Vetch; JCS 110 *OSH*, 943.

LINACEAE

**Linum perenne* L.; Perennial Flax; JCS 607 *MICH, OSH*; near meadow maintained by MDNR.

OXALIDACEAE

**Oxalis fontana* Bunge (*Oxalis stricta* L); Oxalis or Wood-sorrel; JCS 173 *MICH*, 643.

GERANIACEAE

Geranium maculatum L., Wild Geranium or Crane's-bill; JCS 030 *MSC*, 565, 681; abundant in understory of mature forests, especially beech and maple.

RUTACEAE

Zanthoxylum americanum Miller; Prickly-ash; JCS 192 *MSC*, 521

POLYGALACEAE

Polygala paucifolia Willd.; Fringed Polygala, Gay-wings, or Flowering-wintergreen; JCS 051.

EUPHORBIACEAE

Euphorbia corollata L.; Flowering Spurge; JCS 136 *MICH*, 1039.
**Euphorbia cyparissias* L.; Cypress Spurge; JCS 179; one population along roadside near dog trial area on Five Lakes Road.

ANACARDIACEAE

Rhus typhina L. (*Rhus hirta* elsewhere), Staghorn Sumac; JCS 111 *OSH*; roadsides, along trails and in some open areas creating large colonies.
Toxicodendron radicans (L.) Kuntze, Poison-ivy; JCS 331; common in disturbed areas and sometimes reaching shrub size.
Toxicodendron vernix (L.) Kuntze, Poison Sumac; JCS 346, occasional in wet areas, especially bog near Cedar Lake and fen at southern end of Sawdel Lake.

AQUIFOLIACEAE

Ilex verticillata (L.) A. Gray; Michigan Holly, Winterberry, or Black-alder; JCS 407, 584, 928.

CELASTRACEAE

Celastrus scandens L.; Climbing or American Bittersweet; JCS 384 *MICH*.
Euonymus obovata Sm.; Running Strawberry-bush; JCS 042, 391; fairly common in many deciduous forests.

STAPHYLEACEAE

Staphylea trifolia L.; Bladdernut; JCS 1059; occasional along riparian habitat of Flint River.

ACERACEAE (SAPINDACEAE)

Acer rubrum L.; Red Maple; JCS 488, 574, 635 *OSH*.
Acer saccharinum L.; Silver Maple; JCS 1181.
Acer saccharum Marsh.; Sugar Maple; JCS 248 *OSH, MSC*, 487.
Acer negundo L.; Boxelder; JCS 118 *OSH*.

BALSAMINACEAE

Impatiens capensis Meerb.; Spotted Touch-me-not; JCS 247 *MSC*; locally common in wet soils, especially near creeks and lakes.

RHAMNACEAE

Ceanothus americanus L.; New Jersey Tea; JCS 741, 138, 212 *MICH*.
Rhamnus alnifolia L`Her; Alder-leaved Buckthorn; JCS 787; scattered on fen on Sawdel Lake.

VITACEAE

Parthenocissus inserta (A. Kerner) Fritsch; Vinginia Creeper or Woodbine; JCS 121 *OSH, MSC*.
Vitis riparia Michaux; River-bank Grape; JCS 119, 394.

MALVACEAE

**Abutilon theophrasti* Medicus; Velvet-leaf; JCS 1208; uncommon, occurring in food plot maintained by MDNR east of Farnsworth Road.
**Hibiscus trionum* L.; Flower-of-an-hour; JCS 1193.
**Malva moschata* L.; Vervain Mallow; JCS *1038 MICH*.

TILIACEAE (MALVACEAE)

Tilia americana L.; Basswood or Linden; JCS 122.

CLUSIACEAE (HYPERICACEAE)

**Hypericum perforatum* L.; Common St. John's-wort, Klamath Weed, or Goatweed; JCS 139 *MSC*, 749, 972, 1155; fairly common in drier, sandy sites.
Hypericum prolificum L.; Shrubby St. John's-wort; JCS 229 *MICH*, 1188.
Hypericum punctatum Lam.; Spotted St. John's-wort; JCS 187 *MSC*.
Triadenum fraseri (Spach) Gl.; Marsh St. John's-wort; JCS 353 *MICH*; common in Flooding #30.

VIOLACEAE

Viola affinis Le Conte.; Violet; JCS 566.
Viola canadensis L.; Canada Violet; JCS 646; uncommon.
Viola conspersa Reichb. (Viola labradorica Schrank); Dog Violet; JCS 023, 492, 523, 533, 556, 647 *MICH*; common.
Viola cucullata Aiton; Marsh Violet; JCS 554.
Viola pubescens Aiton; Yellow Violet; JCS 035 *MSC*, 493, 498, 524, 547, 553, 734 *OSH*, 1175; common.
Viola renifolia A. Gray; Kidney-leaved violet; JCS 502.
Viola rostrata Pursh; Long-spurred Violet; JCS 572.
Viola sororia Willd.; Common Blue Violet; JCS 022, 478, 496, 505, 638; abundant.
**Viola tricolor* L.; Johnny-jump-up; JCS 669.

ELAEAGNACEAE

**Elaeagnus angustifolia* L.; Russian-olive; JCS 338 *MSC*.
**Elaeagnus umbellata* Thunb.; Autumn-olive; JCS 062 *MICH*, 405 *MICH*, 1123.

LYTHRACEAE

Decodon verticillatus (L.) Ell.; Whorled or Swamp Loosestrife; JCS 351 *MICH*, 991; locally common in some marshy areas.
**Lythrum salicaria* L.; Purple Loosestrife; JCS 208 *MICH*; thankfully uncommon in most predicted habitats.

NYSSACEAE

Nyssa sylvatica Marshall; Sour-gum, Black-gum, or Pepperidge; JCS 127 *MICH*.

ONAGRACEAE

Circaea lutetiana L. (*Circaea canadensis* (L.) Hill); Enchanter's Nightshade; JCS 739.
Epilobium ciliatum Raf.; Willow-herb; JCS 375.
Epilobium coloratum Biehler; Willow-herb; JCS 334.
Epilobium hirsutum L.; Great Hairy Willow-herb; JCS 184 *MICH*, 785.
Oenothera biennis L.; Evening-primrose or Sundrops; JCS 879, 1034, 202, 1168.
Oenothera laciniata Hill; Evening-primrose or Sundrops; JCS 659; seen rarely in sandy meadow east of Five Lakes Road north of Vernor Road.

HALORAGACEAE

Myriophyllum exalbescens Fern. (*Myriophyllum sibiricum* Komrov); Water-milfoil; JCS 825.
**Myriophyllum spicatum* L.; Eurasian Water-milfoil; JCS 280; uncommon in Long Lake.
Myriophyllum verticillatum L.; Water-milfoil; JCS 934, 937, 989 *MICH*; found only in Watz Lake and flooding #13.

ARALIACEAE

Aralia racemosa L.; Spikenard; JCS 849 *MICH*; uncommon to rare.
Aralia nudicaulis L.; Wild Sarsaparilla; JCS 049 *MICH*; uncommon.
Panax quinquefolius L. Ginseng; JCS 1401; uncommon.

APIACEAE

**Aegopodium podagraria* L.; Goutweed; JCS 1051; locally common at some old homesites.
Cicuta bulbifera L.; Water-hemlock; JCS 996 *MICH*, 398.
Cryptotaenia canadensis (L.) DC.; Honewort; JCS 688 *MICH*, 861, 1128.
**Daucus carota* L.Queen-Anne's-lace or Wild Carrot; JCS 845; common, especially in disturbed areas: parking lots, roadsides, and food plots.
Heracleum maximum Bart.; Cow-parsnip; JCS 765; seen and collected once from yard waste pile in parking area.
Osmorhiza claytonii (Michaux) C.B. Clarke.; Sweet-cicely; JCS 103, 630 *OSH*, 683 *MICH*; occasional.
**Pastinaca sativa* L.; Wild Parsnip; JCS 1003; collected near old Vernor homestead site near Long Lake.
Sanicula canadensis L.; Black Snakeroot; JCS 1173.
Sanicula marilandica L.; Black Snakeroot; JCS 695, 1403.
Sium suave Walter; Water-parsnip; JCS 1025 *MICH*.
Taenidia integerrima (L.) Drude; Yellow-pimpernel; JCS 064 *MICH*, 701 *MICH*.
**Torilis japonica* (Houtt.) DC.; Hedge-parsley; JCS 237 *MICH*, 854
Zizia aurea (L.) Koch; Golden Alexanders; JCS 612 *OSH*.

CORNACEAE

Cornus alternifolia L. f.; Alternate-leaved or Pagoda Dogwood; JCS 109, 355 *MICH*, 663 *MICH, OSH*.
Cornus amomum Miller; Pale Dogwood; JCS 207.
Cornus canadensis L.; Bunchberry or Dwarf Cornel; JCS 617; uncommon except for wet, seemingly alkaline wet habitats with *Thuja occidentalis*.
Cornus florida L.; Flowering Dogwood; JCS 510 *OSH*.
Cornus foemina Miller; Gray Dogwood; JCS 726 *MICH*.
Cornus rugosa Lam.; Round-leaved Dogwood; JCS 155.
Cornus stolonifera Michx. (*Cornus sericea* L.); Red-osier; JCS 067 *MSC*, 195, 628; fairly common along some lakeshores.

ERICACEAE

Chamaedaphne calyculata (L.) Moench; Leatherleaf; JCS 005, 580; uncommon in some wet and boggy areas.
Gaultheria procumbens L.; Teaberry or Wintergreen; JCS 012; scattered on dry site, especially near pines.
Gaylussacia baccata (Wangenh.) K. Koch; Huckleberry or Crackleberry; JCS 052 *MICH*, 700.
Vaccinium angustifolium Aiton; Low Sweet Blueberry; JCS 503; rare.
Vaccinium corymbosum L.; Highbush Blueberry; JCS 516, 587 *OSH*.

Vaccinium macrocarpon Aiton; Large Cranberry; JCS 885, 1402; scattered on fen at Sawdel Lake.

PYROLACEAE (ERICACEAE)

Chimaphila umbellata (L.) W.P.C. Barton; Pipsissewa or Prince's-pine; JCS 1040; seen and collected once at Oxbow campground on Flint River.

Pyrola elliptica Nutt; Shin-leaf; JCS 1388; uncommon in forest south of Sawdel Lake.

MONOTROPACEAE (ERICACEAE)

Monotropa uniflora L.; Indian-pipe; JCS 361, 747, 856; common.

PRIMULACEAE

Lysimachia ciliata L.; Fringed Loosestrife; JCS 142 *MSC*; wet shore of Watz Lake.

**Lysimachia nummularia* L.; Moneywort; JCS 1030.

Lysimachia quadriflora Sims; JCS 777, 893; occasional on fen at Sawdel Lake.

Lysimachia quadrifolia L.; Whorled Loosestrife; JCS 083 *OSH*.

Lysimachia thyrsiflora L.; Tufted Loosestrife; JCS 085 *MSC*; seen and collected only at eastern end of Watz Lake.

Trientalis borealis Raf.; Star-flower; JCS 036, 618.

OLEACEAE

Fraxinus americana L.; White Ash; JCS 705 *MICH*.

Fraxinus pennsylvanica Marshall; Red or Green Ash; JCS 704 *MICH*, 725 *MICH*, 251 *OSH*; scattered in wet areas.

**Syringa vulgaris* L.; Common Lilac; JCS 058 *MICH*; locally common around old homesites.

GENTIANACEAE

**Centaurium pulchellum* (Sw.) Druce; Centaury; JCS 1194; common in field maintained by MDNR.

Gentiana andrewsii Griseb.; Closed or Bottle Gentian; JCS 377 *MICH*, 999; occasional in some meadows with wet soil.

APOCYNACEAE

Apocynum cannabinum L.; Indian-hemp; JCS 188 *MICH*.

ASCLEPIADACEAE (APOCYNACEAE)

Asclepias exaltata L.; Poke Milkweed; JCS 126, 875; occasional in many deciduous forests.

Asclepias incarnata L.; Swamp Milkweed; JCS 181 *MICH*, 189, 190 *MICH*, 759; common on shores of lakes and other marshy areas.

Asclepias syriaca L.; Common Milkweed; JCS 844; common in drier sites.

Asclepias tuberosa L.; Butterfly-weed; JCS 819; scattered in dry, sandy openings and roadsides.

CONVOLVULACEAE

Calystegia sepium (L.) R. Br.; Hedge Bindweed; JCS 205, 268, 781, 791.

Calystegia spithamaea (L.) Pursh.; Low Bindweed; JCS 718.

**Convolvulus arvensis* L.; Field Bindweed; JCS 816; especially common at MDNR headquarters on Vernor Road and other disturbed areas.

CUSCUTACEAE (CONVOLVULACEAE)

Cuscuta gronovii Roem. & Schult.; Common or Swamp Dodder; JCS 406, 1056; uncommon.

POLEMONIACEAE

Phlox divaricata L.; Wild Blue Phlox; JCS 1125; one population found south of entrance to Duperow Lake east of Five Lakes Road.

Phlox paniculata L.; Perennial Phlox or Garden Phlox; JCS 1050; one population near old homesite near Duperow Lake.

BORAGINACEAE

Hackelia virginiana (L.) I.M. Johnston; Stickseed or Beggar's-lice; JCS 880; one population along trail north of Watz Lake.

HYDROPHYLLACEAE (BORAGINACEAE)

**Nemophila menziesii* Hook & Arn.; Baby blue eyes; JCS 670; common in prairie plantings on Five Lakes Road. This species is native to the far western United States.

VERBENACEAE

Phryma leptostachya L.; (PHRYMACEAE); Lopseed; JCS 133, 326 *MSC.*

Verbena hastata L.; Blue Vervain; JCS 210 *MSC*; occasional in ditches and other wet areas.

LAMIACEAE

Clinopodium vulgare L.; Wild basil; JCS 134 *MICH.*

Collinsonia canadensis L.; Stoneroot or Horse-balm; JCS 951 *MICH.*

**Glechoma hederacea* L.; Ground-ivy, Gill-over-the-ground, or Creeping Charlie; JCS 464.

**Lamium purpureum* L.; Dead-nettle; JCS 600; disturbed areas, MDNR mowed, maintained areas.

**Leonurus cardiaca* L.; Motherwort 112; uncommon.

Lycopus americanus W. P. C. Barton; Bugleweed or Water-horehound; JCS 246, 294, 902 *MICH*; fairly common in moist to very wet areas.

Lycopus uniflorus Michx.; Bugleweed or Water-horehound; JCS 285 *MICH*, 871; wet areas.

Monarda fistulosa L.; Wild-bergamot; JCS 176 *MSC*, 230; dry areas, open meadows, common.

Monarda punctata L.; Dotted or Horse Mint; JCS 1156; sandy areas.

**Nepeta cataria* L.; Catnip or Catmint; JCS 199 *MICH.*

**Origanum vulgare* L.; Oregano or Wild-marjoram; JCS 1028 *MICH*; collected once from parking lot with yard waste.

Prunella vulgaris L.; Self-heal or Heal-all; JCS 165; common.

**Salvia azurea* Lam.; Blue Sage; JCS 1202; collected once in the "desert" at southern end of Sno-den trail.

Scutellaria galericulata L.; Marsh Skullcap; JCS 222 *MICH*, 783, 913.

Scutellaria lateriflora L.; Mad-dog Skullcap; JCS 982 *MICH*, 933, 1057.

Stachys tenuifolia Willd.; Hedge-nettle; JCS 1046.

SOLANACEAE

Physalis heterophylla Nees.; Ground-cherry or Husk-tomato; JCS 702.

**Physalis longifolia* Nutt.; Ground-cherry or Husk-tomato; JCS 312, 866 *MICH*

**Solanum dulcamara* L.; Nightshade or Bittersweet; JCS 084 *OSH*; common.

Solanum ptychanthum Dunal; Black Nightshade; JCS 948; disturbed areas.

SCROPHULARIACEAE (OROBANCHACEAE AND PLANTAGINACEAE)

Agalinis purpurea (L.) Pennell (Orobanchaceae); Gerardia; JCS 328, 939, 1005.

Chelone glabra L. (Plantaginaceae); Turtlehead; JCS 358 *MSC*; uncommon in wet areas.

**Linaria vulgaris* Miller; (Plantaginaceae); Butter-and-eggs; JCS 865 *MICH.*

Mimulus ringens L.; Monkey-flower; JCS 159, 271; wet areas near Long Lake.

Pedicularis lanceolata Michx.; (Orobanchaceae); Lousewort; JCS 891.

Pedicilus canadensis L.; (Orobanchaceae); Lousewort; JCS 033.

**Verbascum thapsus* L.; Mullein; JCS 170; common in disturbed area.

Veronica anagallis-aquatica L. (Plantaginaceae); Water Speedwell; JCS 186, 219 *MICH*, 276c, 839; common in wet areas.

OROBANCHACEAE

Epifagus virginiana (L.) W.P.C. Barton; Beech-drops; JCS 359, 551, 557; common in beech forests.

PLANTAGINACEAE

**Plantago aristata* Michx.; Bracted Plantain; JCS 1151.

**Plantago rugelii* Decne.; Rugel's Plantain; JCS 204 *MSC*, 373 *MICH*; common, especially in parking areas and other disturbed sites.

LENTIBULARIACEAE

Utricularia gibba L.; Bladderwort; JCS 922; collected only in Watz Lake.

Utricularia minor L.; Bladderwort; JCS 940; collected only in Watz Lake.

Utricularia vulgaris L.; Common Bladderwort; JCS 261 *OSH, MSC*, 794, 898, 899, 916, 935; common in most lakes and floodings.

RUBIACEAE

Cephalanthus occidentalis L.; Buttonbush; JCS 971 *MSC*, 1045 *MICH*.

Galium aparine L.; Goosegrass or Cleavers; JCS 045, 552 *MICH*.

Galium boreale L.; Northern Bedstraw; JCS 082 *MICH*, 211, 715 *MICH*, 1384; common.

Galium circaezans Michx.; JCS 148.

Galium lanceolatum Torr.; JCS 691, 872.

Galium tinctorium L.; JCS 335; fairly common in wet areas.

Galium trifidum L.; JCS 900, 901; fairly common along shore of Sawdel Lake.

Galium triflorum Michx.; JCS 860, 1398.

Mitchella repens L.; Partridge-berry; JCS 097, 341

CAPRIFOLIACEAE

Lonicera canadensis Marshall; Fly Honeysuckle; JCS 015 *MICH*.

Lonicera dioica L.; Glaucous Honeysuckle; JCS 615, 771; uncommon.

**Lonicera maackii* (Rupr.) Herder; Amur Honeysuckle; JCS 664 *MICH*; common in disturbed areas and especially around old homesites.

**Lonicera morrowii* A. Gray; Morrow Honeysuckle; JCS 021 *OSH*, 060; common in disturbed areas.

**Lonicera* ×*bella* Zabel; Honeysuckle; JCS 224, 590; fairly common, however, only parental plant *L. morrowii*, not *L. tatarica* was found nearby.

**Lonicera xylosteum* L.; European Fly Honeysuckle; JCS 267; common in disturbed areas.

Sambucus canadensis L. (Adoxaceae); Common Elder; JCS 218 *MICH*.

Sambucus racemosa L. (Adoxaceae); Red-berried Elder or Red Elderberry; JCS 108 *MICH*, 540 *OSH*, 596; common in some deciduous forests and some wet meadows.

Triosteum aurantiacum E.P. Bicknell; Horse-gentian or Feverwort; JCS 679 *MICH*; uncommon.

Viburnum acerifolium L. (Adoxaceae); Maple-leaved Viburnum; JCS 689 *MICH*, 738, 848; common along many trails.

Viburnum lentago L. (Adoxaceae); Nannyberry; JCS 226 *MICH*.

**Viburnum opulus* L. (Adoxaceae); Highbush-cranberry or Guelder-rose; JCS 708 *MICH*, 924 *MSC*; uncommon.

Viburnum rafinesquianum Schult. (Adoxaceae); Downy Arrow-wood; JCS 665 *MICH*; seen and collected only once north of intersection of Vernor and Five Lakes roads.

VALERIANACEAE

Valeriana uliginosa (J. & G) Rydb.; Swamp Valerian; JCS 778, 1386; locally common on fen at Sawdel Lake.

DIPSACACEAE

**Dipsacus fullonum* L.; Wild Teasel; JCS 847; one small population near entrance to Long Lake on Five Lakes Road.

CUCURBITACEAE

Echinocystis lobata (Michx.) Torr. & A. Gray.; Wild-cucumber; JCS 955 *MSC*; locally common in more wet areas.

CAMPANULACEAE

Campanula americana L. (*Campanulastrum americanum* (L.) Small); Tall or American Bellflower; JCS 868 *MICH*; uncommon to rare.

Campanula aparinoides Pursh; Marsh Bellflower; JCS 235 *MSC*, 786, 835, 903; very common in wet areas, especially bog at Cedar Lake and fen at Sawdel Lake.

**Campanula rapunculoides* L.; Roving or Creeping Bellflower; JCS 863 *MICH*; disturbed area.

Triodanis perfoliata (L.) Nieuwl.; Venus's Looking-glass; JCS 113 *MICH*; prairie planting area near dog trial area on Five Lakes Road.

LOBELIACEAE (CAMPANULACEAE)

Lobelia cardinalis L.; Red Lobelia or Cardinal-flower; JCS 1174; riparian habitat along Flint River.

Lobelia inflata L.; Indian-tobacco; JCS 255 *MICH*; uncommon

Lobelia kalmii L.; Kalm's Lobelia or Brook Lobelia; JCS 887; fen at Sawdel Lake.

Lobelia siphilitica L.; Great Blue Lobelia; JCS 322 *MSC.*

ASTERACEAE

Achillea millefolium L.; Yarrow or Milfoil; JCS 116 *MSC*, 214 *OSH*, 686 *MICH*; common, especially in meadows and disturbed areas.

Ambrosia artemisiifolia L.; Common Ragweed ; JCS 316 *MICH*; common in disturbed areas.

Ambrosia trifida L.; Giant Ragweed; JCS 1047; uncommon

Antennaria parlinii Fernald; Pussy-toes; JCS 053 *MSC*, 537, 549, 573; common in small colonies in sandy areas.

**Arctium minus* Bernh.; Common Burdock; JCS 1149; common in disturbed areas and old Vernor homesite.

Aster cordifolius L. (*Symphyotrichum cordifolium* (L.) G. L. Nesom); Heart-leaved or Blue Wood Aster; JCS 362.

Aster laevis L. (*Symphyotrichum laeve* (L.) A. Löve & D. Löve); Smooth Aster; JCS 295.

Aster lateriflorus (L.) Britton (*Symphyotrichum lateriflorum* (L.) A. Love & D. Love); Calico Aster; JCS 1008, 1043, 366 *MICH*, 371.

Aster macrophyllus L. (*Eurybia macrophylla* (L.) Cass); Large or Big-leaved Aster; JCS 288 *MICH*, 364, 877.

Aster novae-angliae L. (*Symphyotrichum novae-angliae* (L.) G. L. Nesom); New England Aster; JCS 370 *MICH*; common.

Aster ontarionis Wiegand (*Symphyotrichum ontarionis* (Wiegand) G. L. Nesom); Lake Ontario Aster; JCS 889, 1203.

Aster praealtus Poiret (*Symphyotrichum praealtum* (Poir.) G. L. Nesom); Willow Aster; JCS 352 *MICH.*

Aster puniceus L. (*Symphyotrichum puniceum* (L.) A. Love & D. Love); Swamp or Purple-stemmed Aster; JCS 379.

Aster umbellatus Mill. (*Doellingeria umbellata* (Mill.) Nees); Flat-topped Aster; JCS 895, 998.

Bidens connata Willd.; Beggar-ticks; JCS 357a, 1026 *MICH.*

Bidens coronatus (L.) Britton (*Bidens trichosperma* (Michx.) Britton); Tickseed-sunflower; JCS

343 *MICH*, 345 *MICH.*

Bidens vulgata Greene; Beggar-ticks; JCS 372 *MICH.*

**Carduus acanthoides* L.; Plumeless Thistle; JCS 245; uncommon

**Centaurea maculosa* Lam. (*Centaurea stoebe* L.); Spotted Knapweed; JCS 178 *MSC*; common in disturbed areas.

**Cichorium intybus* L.; Chicory or Blue-sailors; JCS 250 *MSC*; common along roadsides, parking lots, and other disturbed sites.

**Chrysanthemum leucanthemum* L. (*Leucanthemum vulgare* Lam.); Ox-eye Daisy; JCS 088; common in many disturbed areas.

**Cirsium arvense* (L.) Scop; Canada or Field Thistle; JCS 197, 750; common and sometimes forming large monocultures.

Cirsium muticum Michx.; Swamp Thistle; JCS 926 *MICH*, 987; uncommon in wet areas.

**Cirsium vulgare* (Savi) Ten.; Bull Thistle; JCS 1150.

**Conyza canadensis* (L.) Cronquist; Horseweed; JCS 347 *OSH*; common in many disturbed areas and meadows.

**Coreopsis grandiflora* Sweet; Coreopsis or Tickseed; JCS 114 *MICH*; common in grassy areas maintained by MDNR.

**Crepis tectorum* L.; Hawk's-beard; JCS 672.

**Echinacea purpurea* (L.) Moench; Purple Coneflower; JCS 1161; locally common in some habitat plantings.

Erigeron philadelphicus L; Common or Philadelphia Fleabane; JCS 073, 074 *MICH*, 614, 698, 789; common.

Eupatorium maculatum L. (*Eutrochium maculatum* (L.) E. E. Lamont); Joe-pye-weed; JCS 329 *MSC*; common along some wet shores.
Eupatorium perfoliatum L. Boneset; JCS 158 *MICH*, 293 *MSC*, 342 *MSC*; wet calcareous areas.
Eupatorium purpureum L. (*Eutrochium purpureum* (L.) E. E. Lamont); Green-stemmed Joe-pye-weed 1036 *MICH*,1177
Eupatorium rugosum Houtt. (*Ageratina altissima* (L.) R. M. King & H. Rob.); White Snakeroot; JCS 1031.
Euthamia graminifolia (L.) Nutt.; Flat-topped Goldenrod; JCS 1001 *MICH*.
Gnaphalium macounii Greene (*Pseudognaphalium macounii* (Greene Kartesz); Clammy Cudweed; JCS 959.
Gnaphalium obtusifolium L. (*Pseudognaphalium obtusifolium* (L.) Hilliard & B. L. Burtt); Fragrant Cudweed; JCS 960, 1187.
**Helianthus annus* L.; Common Sunflower; JCS 1195; persisting after planting by MDNR.
Helianthus divaricatus L.; Woodland Sunflower; JCS 172 *MICH*, 289 *OSH*.
Helianthus giganteus L.; Tall Sunflower; JCS 201 *MICH*, 896, 1198.
Helianthus hirsutus Raf.; Hairy Sunflower; JCS 873
**Helianthus maximilianii* Schrad.; Maximilian Sunflower; JCS 820.
Helianthus strumosus L.; Paleleaf Woodland Sunflower; JCS 823 *MICH*.
Helianthus ×laetiflorus Pers; Sunflower; JCS 773.
**Hieracium aurantiacum* L.; Orange Hawkweed or Devil's Paintbrush; JCS 668 *OSH*.
**Hieracium caespitosum* Dumort.; King Devil or Yellow Hawkweed; JCS 723 *MICH*, 1131, 1186.
**Hieracium flagellare* Willd.; Hawkweed; JCS 636.
**Inula helenium* L.; Elecampane; JCS 821 *OSH*; one large population in wet roadside near intersection of Five Lakes and Daley roads.
Lactuca serriola L.; Prickly Lettuce; JCS 314.
**Matricaria discoidea* DC.; Pineapple-weed; JCS 752; parking lots and other disturbed areas.
Prenanthes alba L.; Rattlesnake-root; JCS 393, 888
Rudbeckia hirta L.; Black-eyed Susan; JCS 150; common in many open areas.
Rudbeckia laciniata L.; Tall or Cutleaf Coneflower; JCS 1160.
Senecio aureus L. (*Packera aurea* (L.) A. Love & D. Love); Golden Ragwort; JCS 038 *MICH*, 622 *OSH*; common in very wet areas.
Solidago altissima L.; Tall Goldenrod; JCS 369 *MICH OSH*, 430, 962 *MICH*; common in open fields and forest edges.
Solidago caesia L.; Bluestem Goldenrod; JCS 337, 411 *MICH*; fairly common in deciduous forests.
Solidago canadensis L.; Canada Goldenrod; JCS 356 *MICH*, 878, 894; common.
Solidago gigantea Aiton; Late Goldenrod; JCS 321 *MSC*, 395b; abundant.
Solidago juncea Aiton; Early Goldenrod; JCS 191 *MICH*, 763 *MICH*, 947.
Solidago nemoralis Aiton; Gray Goldenrod; JCS 1000; locally common on drier sites west of Long Lake.
Solidago ohioensis Riddell; Ohio Goldenrod; JCS 431 *MICH*, 892; common on fen at Sawdel Lake.
Solidago patula Willd.; Rough-leaved Goldenrod; JCS 897; swampy areas.
Solidago rugosa Miller; Rough-leaved Goldenrod; JCS 367 *MICH*, 395.
Solidago uliginosa Nutt.; Bog Goldenrod; JCS 236.
Sonchus arvensis L.; Field or Perennial Sow-thistle; JCS 198 *MICH*, 1006, 1053 *MICH*; common in some fields and meadows.
**Tanacetum vulgare* L.; Common Tansy; JCS 764 *MICH*; wet meadow and field.
**Taraxacum officinale* F. H. Wigg; Common Dandelion; JCS 499; common in mowed areas, parking lots and other disturbed areas.
**Tragopogon dubius* Scop.; Goat's-beard; JCS 640 *OSH*.
**Tragopogon pratensis* L.; Goat's-beard; JCS 642 *OSH*.

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A Checklist of Vascular Plants of the Lapeer State Game Area, Lapeer County, Michigan, USA
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On the cover: *Bruce D. Parfitt, a faculty member at the University of Michigan-Flint for 14 years inspired the survey of the LSGA in early 2003. Always writing, Bruce contributed to the Flora of North America (Volumes 4 and 9), The Jepson Manual, and had over 40 peer-reviewed articles on broad topics. Bruce's encyclopedic knowledge helped many undergraduates become interested in plant sciences and then move on to graduate studies. Bruce passed away in September 2009 after a long illness. Photo taken by J.C. Springer, June 2007 in Burlington, Vermont.*

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On all editorial matters, please contact Todd J. Barkman, 3437 Wood Hall, Department of Biological Sciences, Western Michigan University, Kalamazoo, MI 49008; 269. 387. 2776 (Phone), 269. 387. 5609 (FAX); todd.barkman@wmich.edu. All articles dealing with botany in the Great Lakes region may be sent to the Editor at the above address. In preparing manuscripts, authors are requested to follow the "Instructions for Authors" on the inside back cover.

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NOMENCLATURE OF THE THICKET CREEPER, *PARTHENOCISSUS INSERTA* (VITACEAE)

James S. Pringle
Royal Botanical Gardens
P.O. Box 399
Hamilton, Ontario, Canada L8N 3H8

ABSTRACT

Parthenocissus inserta (A. Kern.) Fritsch, rather than *P. vitacea* (Knerr) Hitchc., is the correct name for the thicket creeper, a species related to the Virginia creeper, *P. quinquefolia*.

KEY WORDS: *Parthenocissus*, Vitaceae

Two species of *Parthenocissus* are native to eastern and central North America. One of these, to which the common name Virginia creeper is more appropriately applied, is *P. quinquefolia* (L.) Planch. Its natural range extends from Mexico probably to southern Maine, southern Ontario, and southern Minnesota, although it has escaped from cultivation farther north. The other species, the nomenclature of which is discussed here, has a more northern and western range, from Pennsylvania, Texas, and California north to ca. 50°N in Ontario and Manitoba. "False Virginia creeper," "thicket creeper," and "grape-woodbine" have been proposed as vernacular names for the northern species, but none of these names has become widely used. Because of their abundance and the size of the plants, these species are ecologically important, influencing succession and providing cover and food for wildlife. They are widely cultivated as ornamental vines in North America and Europe, although they may sometimes become a problem, as when shrubs or specimen trees are engulfed.

Until early in the twentieth century few botanists distinguished between these species, and the assumption that "the" Virginia creeper is *Parthenocissus quinquefolia* continues to result in reports of *P. quinquefolia* from localities north of its true range. The two species are most readily distinguished by the size and branching pattern of the inflorescence. An inflorescence of *P. quinquefolia* commonly contains 25 to 200 or more flowers. The primary axis, although it zigzags, is continuous through the inflorescence, with dichotomous branching being limited to the lateral cymules. In the northern species, the inflorescence usually contains 10 to 60 flowers and is dichotomous throughout, with no central axis. These species also differ in the form of the expansions at the tips of the tendril branches, by means of which the vines cling to the surfaces or supports on which they climb. This topic, which is relevant to the nomenclature of these species, is discussed below. Additional differences exist in the shape and glossiness of the leaflets, the size of the fruits, and the number of seeds per fruit.

The nomenclatural history of the southern species, *Parthenocissus quinquefolia*, to 1967 has been reviewed by Webb (1967). Reveal's (in Jarvis 2007) subsequent designation of an unambiguous specimen of that species as the lectotype

of the basionym *Hedera quinquefolia* L. has eliminated uncertainty as to its correct name. The northern species was called *P. inserta* (A. Kern.) Fritsch in *Gray's Manual of Botany*, ed. 8 (Fernald 1950), and *P. vitacea* (Knerr) Hitchc. in the *New Britton and Brown Illustrated Flora* (Gleason 1952). It has been called *P. inserta* in some more recent references, e.g., Staff of the Liberty Hyde Bailey Hortorium (1976), Voss (1985), Huxley et al. (1992), Swink and Wilhelm (1994), Cooperrider (1995), Newmaster et al. (1998), and Rhoads and Block (2007), and *P. vitacea* in others, including Gleason and Cronquist (1991), Moore (1993), Kartesz (1999), Wetter et al. (2001), Newmaster and Subramanyam (2005), Magee and Ahles (2007), and Dirr (2009). Recent use of the latter name has sometimes been accompanied by a citation of its acceptance in another flora or by an unsupported statement that the name *P. inserta* was misapplied to the northern species, but seldom by the citation of any nomenclatural study. The exceptions cite a paper by Gleason (1947), which is discussed below.

The southern and northern taxa, as varieties of *Ampelopsis hederacea* DC., were first distinguished taxonomically by Focke (1875), who had observed these taxa in cultivation in Germany. He designated the northern taxon *A. hederacea* var. *dumetorum*. The first to divide *Parthenocissus quinquefolia* s. lat. into two species equivalent to those currently accepted was Kerner von Marilaun in 1887. Kerner, who included these species in *Vitis* L., and who did not refer to Focke's paper, divided the broadly circumscribed species into *V. quinquefolia* (L.) Lam. s. str. and *V. inserta* A. Kern. Probably because the latter name was published in an ecological rather than a taxonomic work, by an author whose newly described species were mostly European, this taxonomic innovation did not immediately become well known among North American botanists. In Ohio, Lazenby (in Lazenby and Werner 1890) independently distinguished the two taxa morphologically in 1890, calling the northern taxon "a well-defined variety," but he did not distinguish it by name. Knerr, in 1893, without reference to any of these earlier publications, divided *P. quinquefolia* s. lat. [as *Ampelopsis quinquefolia* (L.) Michx.] into the nominate variety and var. *vitacea* Knerr, applying the latter name to the northern taxon. The following year Hitchcock (1894) raised Knerr's variety to species status as *Parthenocissus vitacea* (Knerr) Hitchc.

Wider recognition of the two species was fostered by the publication of several works by Rehder. In Sargent's *Trees and Shrubs* (Rehder 1905a) he provided a detailed description and illustration of the northern species as *Parthenocissus dumetorum* (Focke) Rehd., that name being a new combination based on *Ampelopsis hederacea* var. *dumetorum* Focke. Competing codes of nomenclature still existed at that time, and Rehder was probably following an old rule whereby the priority of an epithet was not limited by taxonomic rank. As he included the older specific name *P. vitacea* in synonymy, the name *P. dumetorum* is illegitimate under current rules, which provide that an epithet has priority only within the rank or ranks in which it has been published. In two slightly later papers (Rehder 1905b, 1908) on the systematics of the North American species of *Parthenocissus* (in 1908 as *Psedera* Necker), Rehder applied the specific epithet *vitacea* to the northern species, with no mention of the epithet *inserta*.

Fritsch called attention to the older epithet *inserta* in 1922, and published the new combination *Parthenocissus inserta*. In 1939, by which time he was again using the generic name *Parthenocissus*, Rehder, citing Fritsch, noted the exis-

tence of the earlier specific epithet and began using the name *P. inserta* (A. Kern.) Fritsch. In some manuals the name *P. vitacea* has been accepted with *P. inserta* given as a synonym, but that treatment is incorrect; if the two names are regarded as heterotypic synonyms, the epithet *inserta* has priority at the rank of species. The nomenclatural uncertainty is due to a question as to the species to which the earlier epithet, *inserta*, was originally applied.

As described (as *Vitis*) by Kerner (1887, seen in translation by Oliver), the tendrils of *Parthenocissus quinquefolia* s. str. form discs upon contact with a wall or other surface. These discs, which Kerner likened to the toes of a tree frog, expand and secrete a sticky substance. They become cemented to the surface on which they climb, and adhere firmly even to smooth surfaces such as glass or polished iron, although this species is most often seen climbing on trees. In the other species, which Kerner called *Vitis inserta*, expansion of the tendril tip does not take the form of a disc, but occurs only after it has become inserted into a narrow crevice, as in bark. Upon expansion, a callus develops and the tendril tip becomes tightly wedged in the crevice (the principle of Chair-lok, for a modern simile). Its external cells closely conform to the irregularities of the surfaces of the crevice—in Kerner's words, translated, looking "as if melted wax had been poured into the crevice and then solidified." Kerner believed that light or its absence was a factor in expansion of the tendril tips, because *V. quinquefolia* formed discs merely upon contact with a surface, whereas in *V. inserta* tendril-tip expansion occurred only in the dark interior of a crevice.

Kerner used the name *Vitis inserta* in a discussion of tendrils as though it had already been published. He may have intended to name the new species in a paper that was never published, or to include it in exsiccatae that were never distributed. Despite this departure from the usual format for naming a new taxon, Kerner clearly used the binomial *Vitis inserta* as the name of a species, and his description and illustration of the tendrils were diagnostic in distinguishing that species from *V. quinquefolia*, thus meeting the retroactive requirements for valid publication of a botanical name in 1887, as recognized by Gleason (1947) and Webb (1967). Kerner did no field work in North America, but his detailed description of the tendrils of *V. inserta* indicates that he had observed the growth of plants over time. His illustration indicates that he had seen tendrils with their tips in crevices in bark, which would not usually be present with herbarium specimens. It seems likely, therefore, that he had studied live plants, probably in the botanical garden in Vienna. He cited no specimens with this description of tendrils, probably not considering the *Pflanzenleben* an appropriate context. The "Virtual Herbaria" Web site of the Institute of Botany, University of Vienna (2006), indicates that neither the herbarium of the Natural History Museum Vienna (W) nor that of the University of Vienna (WU), where specimens collected or studied by Kerner would be expected, contains any specimens either of North American or of garden origin relevant to the nomenclature of this species.

Gleason, whose passion for nomenclatural stability has become legendary, addressed the nomenclature of the northern species in 1947, in a paper with the stated objective of preserving familiar binomials. By that time the two species had been distinguished as *Parthenocissus quinquefolia* and *P. vitacea*, respectively, by Robinson and Fernald (1908) in the seventh edition of *Gray's Manual* and by Rydberg (1923) in his *Flora of the Rocky Mountains*, ed. 2. Even in 1947,

however, use of the name *P. vitacea* did not prevail completely in widely used references, as the name *P. inserta* had been used in Rehder's (1940) *Manual of Cultivated Trees and Shrubs*, ed. 2, and in Deam's (1940) *Flora of Indiana*. The name *P. inserta* would soon become even more familiar, with the publication of Rehder's (1949) *Bibliography of Cultivated Woody Plants*, Bailey's (1949) *Manual of Cultivated Plants*, ed. 2, Fernald's (1950) revision of *Gray's Manual of Botany*, and Kearney and Peebles' (1951) *Arizona Flora*, ed. 1, in all of which the northern and western species was called *P. inserta*. Had it not been for Gleason's intervention, the name *P. inserta* might quickly have gained general acceptance and use. As it was, Gleason's attempt to preserve and stabilize the use of the name *P. vitacea* did not have the intended effect, but was followed instead by persistent uncertainty and discrepancy among widely used references. It is hoped that this study will help to allay this uncertainty.

Weber and Wittman's (1999) statement that Gleason (1947) had "examined the type [of the name *Vitis inserta*] and found it to be *P. quinquefolia*" is incorrect. Gleason neither mentioned a type specimen nor cited any specimens in relation to the name *Vitis inserta*, nor is any type or specimen appropriate for designation as a lectotype known to exist.

Gleason (1947) quoted Kerner's translated description of the tendrils of *Vitis inserta*, paraphrased above, and followed it with his own interpretation of Kerner's illustration of that species: "Each [tendril] apex has found a crevice in the bark and has there enlarged into an adhesive disk." He concluded that since "*P. vitacea* is the plant almost always without holdfasts . . . *Vitis inserta* is merely a synonym of *P. quinquefolia*."

The largest tendril shown in Kerner's illustration has entered a crevice in bark, but the figure does not show the tip of that tendril. It does not show what happened with the tip after it entered the crevice, certainly not that it enlarged into an adhesive disc. Nearer the top of the figure another tendril is shown, which appears to terminate in a very small, probably immature, rough-surfaced enlargement, but that part of the figure is not clear as to whether any part of that tendril is concealed in a crevice. This small enlargement does not resemble in size or shape an adhesive disc of *Parthenocissus quinquefolia*.

Kerner had contrasted two species in both of which the tips of the tendril branches produced expanded structures that enabled the vines to cling to the surfaces on which they climbed. The contrast was in the morphology and anatomy of the expanded tendril tips, and the microenvironments conducive to their formation, rather than in the frequency with which such structures were produced. Kerner distinguished *V. inserta*, which according to his own description does not form true discs, the terminal growth of the tendrils specifically being contrasted with discs, and for which "smooth surfaces . . . afford no suitable hold" (Kerner 1887, translation), from *V. quinquefolia*, which produces sticky discs, in a strict definition of discs, and can cling to smooth surfaces. It was not consistent or compatible with Kerner's use of the name *V. inserta*, therefore, to state that he had applied that name to the species that does form true discs and can adhere to smooth surfaces.

Although it appears largely to have been overlooked, perhaps in part because its title mentions only *Parthenocissus quinquefolia*, there is a nomenclatural

study of North American *Parthenocissus* more recent than Gleason's, by Webb in 1967. Webb, who accepted the name *P. inserta* for the northern species, concluded that Kerner's text and illustration of *Vitis inserta* left "no doubt in [his, Webb's] mind as to the type of tendril the author was describing, and this character alone is adequate for diagnosis." This conclusion is the same as that reached in the present study.

Kerner's contrast of the species is compatible with later observations and descriptions, notably those by Voss (1985), who described *Parthenocissus quinquefolia* as having "tendrils with each branch forming an adhesive disc at the end if it comes in contact with a support," and *P. inserta* as having "tendrils not developing discs (although sometimes club-shaped when in a crevice)."

I concur with Webb (1967) that the basionym *Vitis inserta* was originally applied to the species called *Parthenocissus inserta* by Fernald (1950), Voss (1985), and Cooperrider (1995); that is, that *P. inserta* is the correct name for the more northern and western of the two species discussed here.

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HOST PREFERENCES OF BEECHDROPS (*EPIFAGUS*): EVIDENCE FROM CHLOROPLAST DNA SEQUENCE DATA

Jianhua Li*, Jeffrey Corajod, and Jeffrey DeYoung
Department of Biology
Hope College
Holland, MI 49423, U.S.A.

ABSTRACT

In nearly two hundred years, botanists and the general public have assumed that *Epifagus virginiana* (beechdrops) parasitizes specifically on the roots of *Fagus grandifolia* (American beech tree). In this study we used sequences of the chloroplast gene *rbcL* from host roots of beechdrops to test the long-held theory. Host roots on which *Epifagus* grows were randomly collected from four localities in western Michigan. Our data show that although roots of maple and beech are intricately interwoven with the grappler roots of *Epifagus*, all of our root samples for which we verified the host-parasite direct connections under dissecting microscope were from American beech trees (*Fagus grandifolia*) except for one from *Acer saccharum*. The potential beechdrop-sugar maple relationship needs further verification from physiological investigations. Therefore, our DNA sequence data support the host preference of *Epifagus* on roots of *Fagus* and suggest that parasite-root interactions may be complex and DNA barcoding can be useful for studying the host preference of parasitic plants.

KEYWORDS: *Epifagus*, *Fagus grandifolia*, *Acer saccharum*, host specificity.

Holoparasitism has evolved more than 10 times in the evolutionary history of flowering plants (Barkman et al. 2007) and parasitic angiosperms belong to 22 families, 265 genera, and over 4000 species (Nickrent et al. 1998). Orobanchaceae are the largest parasitic family (Bennett and Mathews 2006) and consist of 65–87 genera (Wolfe et al. 2005; Judd et al. 2008), including *Epifagus* Nutt. (Beechdrops). *Epifagus* was first discovered in Virginia, U.S.A. and was given the name *Orobanche virginiana* by Linnaeus (Linnaeus 1753). It was Nuttall (1818) who pointed out the generic differences between *Orobanche* and the beechdrops, and first used the name *Epifagus* to refer to its parasitic habit on the roots of beech tree, *Fagus grandifolia* Ehrn. However, Barton (1818) was the first to publish the species name *Epifagus virginiana*.

Epifagus occurs mainly in eastern North America with some extension to Central America and has a general co-existence with *Fagus grandifolia* (Thieret 1969). People have dug and traced host roots to beech trees (Schrenk 1894). However, this is not always possible since host roots are generally fine ones and easily broken (Thieret 1969). Nevertheless, *Epifagus* has always been considered as growing solely on the roots of *Fagus grandifolia* since its original description (Barton 1818; Nuttall 1818; Schrenk 1894; Thieret 1969; Heide-Jørgensen 2008).

*Author for Correspondence: Department of Biology, Hope College, 35 E 12th Street, Holland, MI 49423, U.S.A. e-mail: li@hope.edu, phone: 616-395-7460, fax: 616-395-7125.

In recent years DNA barcoding has been used to help identify plant species (Kress et al. 2005), and the technique is also found to be useful for ecological studies (Valentini et al. 2009). Zhang et al. (2009) used sequences of nrDNA internal transcribed spacer regions to help determine hosts of holoparasitic plant *Cynomorium*. The objective of the current study is to provide molecular test for the traditional view that *Epifagus* is an obligate parasite on the roots of *Fagus grandifolia* using nucleotide sequences of chloroplast gene *rbcL* because the gene has been widely used in phylogenetic studies (Chase et al. 1993) and recently recommended as a DNA barcoding marker for plants (Kress et al. 2005).

MATERIALS AND METHODS

Sixteen plants of *Epifagus* and their associated potential host roots were collected from four localities of western Michigan, each with 1–5 samples. The sampled individuals were widely spaced out to minimize the possibility of having hosts from the same beech tree. Because *Epifagus* uses its grappler roots to get hold of fine roots of a potential host and then forms haustoria to complete tissue connections with the host (Schrenk 1894), we brought the samples to lab to clean the roots and verify the parasite-host tissue fusion under a dissecting microscope (Fig. 1). Genomic DNAs of the potential host roots (with or without tissue connections with the parasite) were extracted using a Plant DNeasy Mini Kit (Qiagen, CA). Polymerase chain reactions (PCR) were conducted to amplify the chloroplast *rbcL* gene using primers rbcl5 and rbcl3 (Olmstead et al. 1992) and the thermocycler program of Jiao and Li (2007) in an Eppendorf MasterCycler Pro thermocycler. PCR products were purified using a Qiaquick PCR purification kit (Qiagen, CA, cat. #28106), and sequenced using the BigDye fluorescent chemistry (Applied Biosystems, CA). Sequences were obtained using a Genetic Analyzer 3130 (Applied Biostystems) at Hope College, and edited using Sequencher (version 4.1, GeneCode, Ann Arbor, MI).

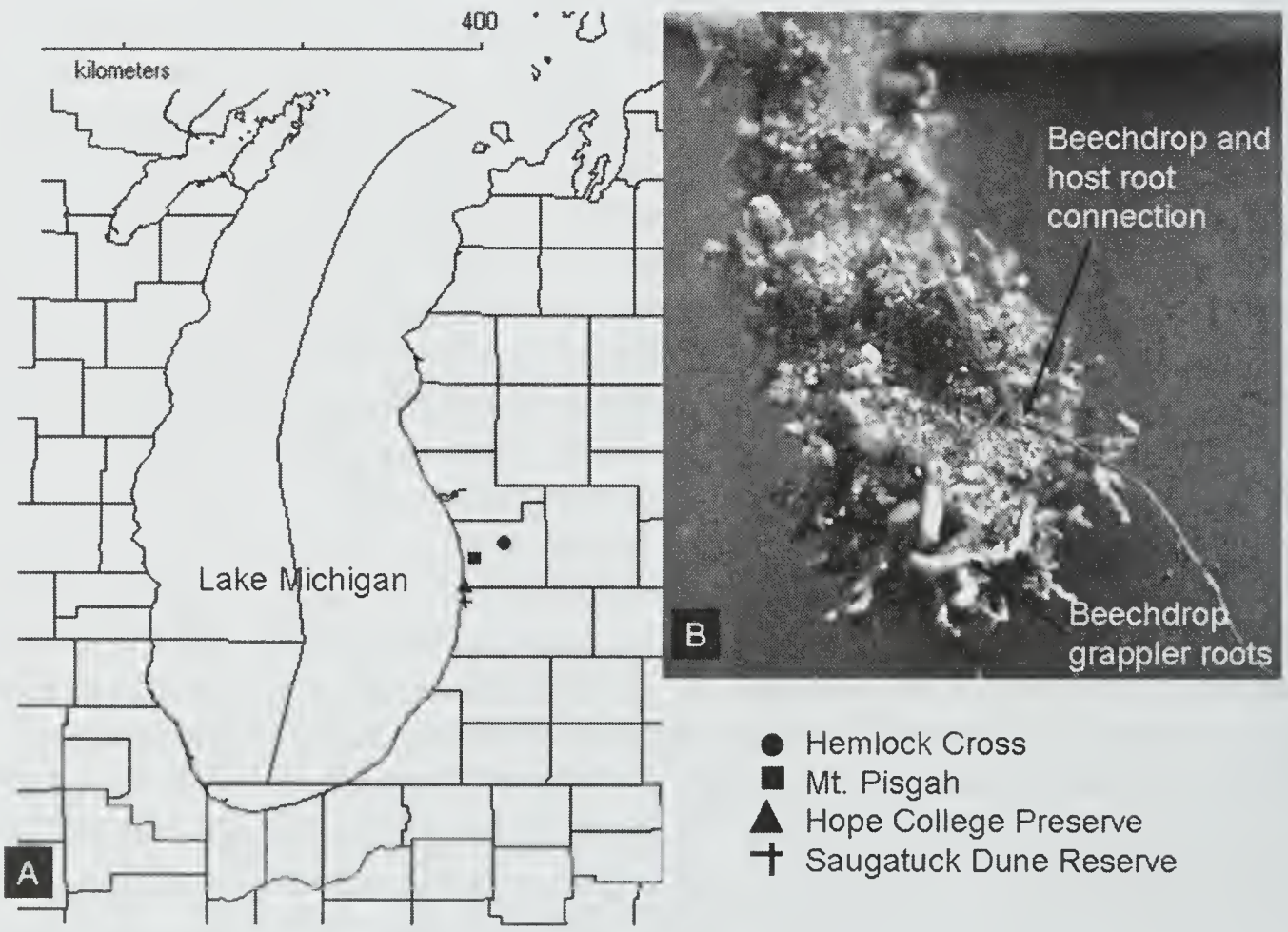

FIGURE 1. Sample sites in western Michigan (A) and connection between *Epifagus* and host root (B).

We compared our new sequences with those in the GenBank using the BLAST function (www.ncbi.nlm.nih.gov). Because our BLAST analyses indicated that the sequences were most similar to those in the rosids, our phylogenetic analyses were limited to the rosids clade. An *rbcL* data set (M3534.NX) of the rosids was obtained from TreeBASE (www.treebase.org) and to it we added our new sequences and additional *rbcL* sequences of *Fagus* and *Acer* from the GenBank. The sequences were readily aligned manually. Maximum parsimony analyses were performed on the data set using PAUP* (version 4.0b10) (Swofford 2002), and the heuristic tree search options included 100 random sequence addition with 10 trees held each replicate, MaxTrees set to 5,000, TBR branch swapping, Multrees on, and steepest descent off. Bootstrap analyses (Felsenstein 1985) of 100 replicates were used to estimate relative support for individual clades and heuristic tree search options were as in parsimony analyses except for simple sequence addition

RESULTS

Sequences of the *rbcL* gene were obtained from all sampled roots, and their lengths ranged from 1329–1371 bp. BLAST analyses showed that a majority of our sequences were most similar to *Fagus*, while a few new sequences had high affinity scores with *Acer*. Sequences were identical in several samples of the same species and only one sequence was submitted to the GenBank (*Fagus grandifolia*: GU434292, *Acer saccharum*: GU434290, and *Acer rubrum*: GU434291). In the MP trees (Fig. 2), all but one sequences from roots that were verified to have direct tissue connection with the haustoria of *Epifagus* formed a clade with *Fagus grandifolia*. In contrast, sequences from potential host roots that were tightly grabbed by *Epifagus* grapplers but had no direct connection with the haustoria of *Epifagus* were from either *Fagus* or *Acer*. One root sample with verified tissue connection with *Epifagus*, however, turned out to be from *Acer saccharum*.

DISCUSSION

Since the initial description of *Epifagus virginiana*, it has generally been accepted that *Epifagus* parasitizes only on the roots of *Fagus grandifolia* (Barton 1818; Nuttall 1818; Schrenk 1894; Thieret 1969; Heide-Jørgensen 2008). The long-held view has been based only on field observations tracing parasitized roots to host trees (Barton 1818; Schrenk 1894; Thieret 1969). Such observations have great accuracy but are not an easy task (Thieret 1969) and are limited in nature. So far there are no other lines of evidence to confirm the unique host-parasite relationship between *Epifagus* and *Fagus grandifolia*. In our random sampling of 16 potential host roots in four localities of western Michigan, we observe that all roots (with one exception) that have tissue connections with the haustoria of *Epifagus* are from beech trees, confirming the long-held view of the host-parasite relationship.

Epifagus is essentially coexistent with *Fagus grandifolia* (Thieret 1969), while *Acer saccharum* and *Fagus grandifolia* often grow in association with each other (Daubenmire 1978; Elias 1980). In our study sites *Fagus grandifolia* is accompanied by both *Acer saccharum* and *Acer rubrum*. Thus, it is not sur-

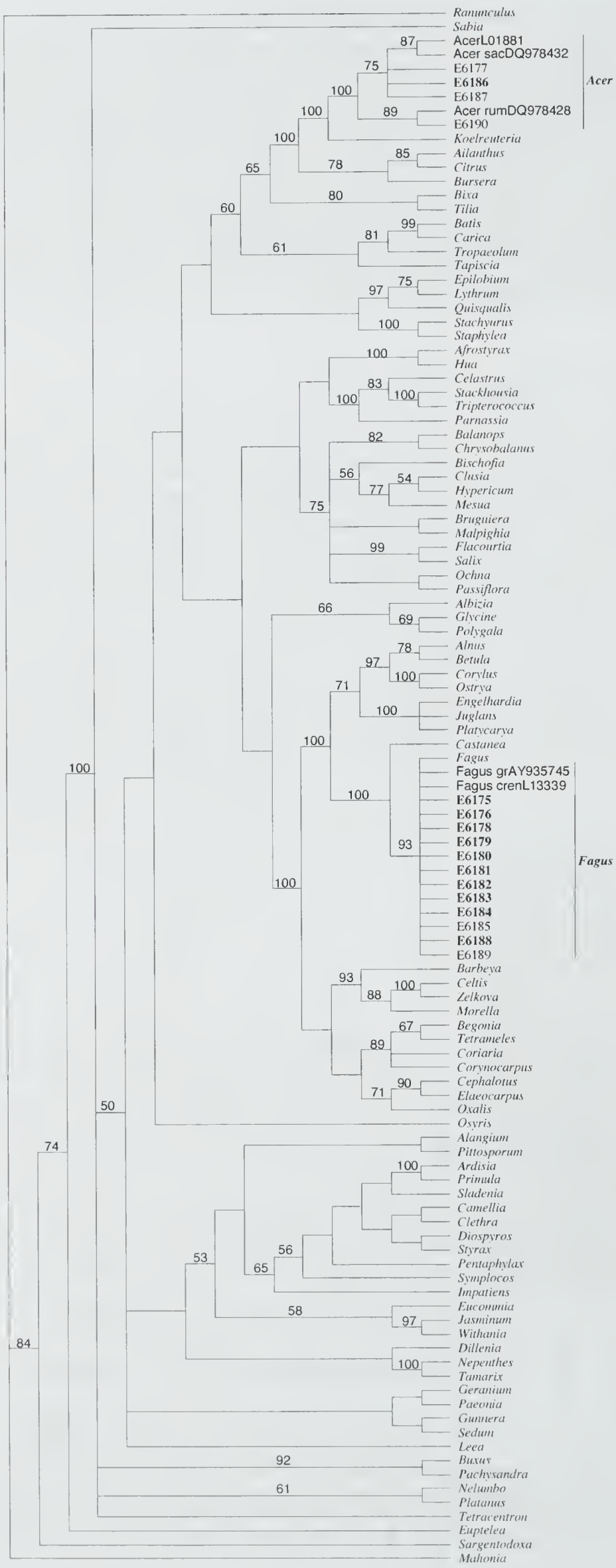

FIGURE 2. Strict consensus of 5,000 trees based on parsimony analyses of *rbcL* sequences of the rosids. All sequences are obtained from the GenBank except for the new sequences (E6175-E6190) and samples with verified tissue connections with *Epifagus* are in boldface. Numbers above branches show bootstrap percentages.

prising that some of the roots *Epifagus* holds on tightly using its grappler roots are from *Acer saccharum* or *A. rubrum*. However, only one of the maple roots had direct tissue connection with the haustoria of *Epifagus*. We have not observed any of the *Epifagus* samples having tissue connections with more than one host roots. Nevertheless, we can not rule out the possibility that there had been a beech-*Epifagus* tissue connection before the formation of the tissue fusion with the root of *Acer saccharum*. Therefore, our study suggests that *Epifagus* parasitizes nearly specifically on the roots of *Fagus grandifolia*. It is desirable to obtain additional samples from more populations to further test the hypothesis and to conduct histological studies to further verify the haustorial connections between *Epifagus* and *Acer saccharum*.

With cross contamination in mind, we did not sequence the *rbcL* gene from leaf samples of *Fagus grandifolia*, *Acer saccharum*, or *A. rubrum*. Instead, we used the existing *rbcL* sequences in the GenBank. Therefore, our DNA barcoding data for the first time provide alternate, unequivocal support for the high host preference of *Epifagus* on beech trees, and indicate a possible occasional association between *Epifagus* and *Acer saccharum*. However, the latter association needs further reevaluation with additional samples and histological verification of the host-parasite connection.

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VASCULAR PLANT SURVEY OF PRIVATELY OWNED WETLANDS, PAVILION TOWNSHIP, KALAMAZOO COUNTY, MICHIGAN

Kathleen M. Baker and C. Elizabeth Whately

Western Michigan University
Department of Geography
Kalamazoo, MI 49008-5424

ABSTRACT

Pavilion Township has extensive wetland areas that were not accessible for evaluation during the writing of two extensive floras of Kalamazoo County due to private ownership. Although not historically surveyed, these wetlands contain diverse habitats that contribute to the biodiversity and overall floristic quality of the township and the county. A vascular plant survey was completed for a 40 acre (16ha) tract of privately owned wetlands in the township. The survey was performed from April 2008 through September 2008. The resulting vascular plant list contains 292 species, representing 81 families and 180 genera. Of these taxa 80 percent are native, including one new county record. Wetland communities at the site include emergent marsh, seepage bog/fen with associated shrub swamp and tamarack swamp forest, and red maple swamp forest. The Floristic Quality Index for the area was 68, considerably above the state threshold of 50 for extremely rare communities.

KEY WORDS: Kalamazoo County, Michigan, Vascular Plant, Wetland

INTRODUCTION

Privately owned natural areas are often not surveyed during the compilation of regional floras. Even when surveys are conducted in these areas, landowners are at times hesitant to allow publication of exact location of rare species and rare community types. Pavilion Township in Kalamazoo County, Michigan, has several areas of unsurveyed wetlands that are only tangentially mentioned in the floras of the county (Hanes and Hanes 1947; McKenna 2004). This study documents the vascular plant flora of 40 acres of one contiguous, well-preserved, privately-owned wetland in the region. Repeated floristic inventories of relatively small tracts, less than 100 ha, over time are a useful way of documenting the effects of invasive species, high deer populations, and climate change on regional diversity and floristic quality (Judziewicz 2004). Plant survey information is also valuable for landowners who currently make management decisions in the township. It is hoped that this isolated wetland system will remain undisturbed and become an area for longitudinal study in the region. A floristic inventory, supported by dried herbarium specimens, and a description of floristic quality of the area is provided in this report. Results may be included in future floras of the county.

METHODS AND MATERIALS

Study Site

Kalamazoo County is half way between Chicago, Illinois to the west and Detroit, Michigan to the east. Pavilion Township (T3S; R10W) is located in the east central portion of Kalamazoo County in southwest Michigan. The surface geology of Kalamazoo County is glacial in origin. The landforms today were largely formed during the Wisconsin glaciation. The last glaciers retreated from the region approximately 11,000 years ago. Pavilion Township lies on an outwash plain deposited by flowing meltwater (Passero et al. 1978). Kettle depressions are common in the outwash plain and the study site is within one such depression.

The Soil Survey of Kalamazoo County (Soil Conservation Service 1979) classifies the soils of most of this area as Houghton muck, which is common in areas where a high water table retards the breakdown of the organics. Along the edges of emergent marsh, soil cores taken by the author have shown that Houghton muck overlays gravel and Sleeth loam. Depth of the muck layer becomes deeper as the water table increases in height. Further into the marsh, 18-24 inches of peat overlays marl. The peat layer increases in thickness toward a bog/fen with associated shrub swamp and floating tamarack swamp forest. Local reports indicate a solid bottom to be approximately 12-20 feet below the floating tamarack swamp, but this has not been verified.

National Climatic Data Center normals (NCDC 2002) at Kalamazoo State Hospital show that mean monthly temperatures in the area range from –8°C (17°F) in January to 29°C (84°F) in July. The growing season varies from 145-155 days. Average precipitation is 95 cm (37.4 in), with higher precipitation during the growing season. Monthly average precipitation is highest in September, 10.4 cm (4.10 in), and lowest in February, 4.5 cm (1.76 in).

Plant communities in the study site, as described by McKenna (2004), include emergent marsh, a seepage bog/fen with associated shrub swamp and tamarack swamp forest, and red maple swamp forest wetland communities. Smaller areas of pasture and old field are also present in the study site. At the request of the landowners, the exact location of the tract is not described here.

A permanently inundated emergent marsh (Figure 1) is dominated by *Typha latifolia* and occurs where Houghton muck transitions to Sleeth loam. For several decades the higher, loamy areas have been used as pasture and cropland, leading to some eutrophication of the adjacent wetlands and in-

FIGURE 1. Emergent marsh, March 8, 2008. Photograph by Kathleen Baker.

FIGURE 2. Shrub swamp, July 3, 2008. Photograph by Kathleen Baker.

troduction of the pasture species *Dactylis glomerata, Phleum pratense, Trifolium hybridum*, and others. Shrub swamp (Figure 2) acts as an interface between emergent marsh and tamarack swamp forest. Typical species in the shrub swamp include *Cephalanthus occidentalis* and *Cornus* spp. The tamarack swamp (Figure 3), dominated by *Larix laricinia* and *Toxicodendron vernix*, is difficult to access through the shrub swamp moat. A tamarack swamp forms a mosaic with the seepage bog/fen. Local concentrations of bog plants, including *Pogonia ophioglossoides, Sarracenia purpurea* (Figure 4), and *Vaccinium* spp. alternate with typical fen species, such as *Calopogon tuberosus* (Figure 5) and *Potentilla palustris*, on the *Sphagnum* and *Larix* mat. Seasonally flooded areas at the outer extent of these wetlands are dominated by red maple swamp forest (Figure 6) where Houghton muck transitions to Sebewa loam.

An archeological survey of the sections surrounding the wetlands found projectile points, flakes and biface fragments that indicate the area was used as hunting grounds by Archaic, Late Archaic/Early Woodland and Middle Woodland Native Americans (Cremin et al. 1984). In the last 50 years anthropogenic impacts have included selective cutting of trees, pasturing of cattle in some upland and marsh locations, and limited mowing and/or cultivation of the uplands (pers. comm. with land owner).

Methods

Vascular plants were collected from April 2008 to September 2008. In order to obtain as complete an inventory as possible, all plant community types were searched approximately every three weeks. Angiosperms, except for some trees, were collected in flower or with fruits. Gymnosperms were collected without cones, and pteridophytes and their allies were collected with sporangia when possible. Voucher specimens for all taxa listed below are being deposited in the Hanes Herbarium, Western Michigan University (WMU). Six of these specimens were collected June 2010 to supplement previous collections. Voucher specimens for *Toxicodendron radicans* and *T. vernix* are photos only. Nomenclature generally follows *Michigan Flora* vol. 1–3 (Voss 1972; 1985; 1996) for gymnosperms, monocots, and dicots and *Flora of North America* vol. 2 *Pteridophytes and Gymnosperms* (Flora of North America Editorial Committee 1993) for ferns and their allies. Additional references

FIGURE 3. Tamarack swamp, June 19, 2008. Photograph by Kathleen Baker.

used for identification of specimens include Crow and Hellquist (2000a, 2000b), Gleason and Cronquist (1991), and Holmgren (1998). Introduced species were determined according to Michigan's floristic quality assessment (Michigan DNR 2001) and Michigan's Special Plants (Michigan DNR 2009) was used to determine species which were threatened or of special concern in the state of Michigan.

The Floristic Quality Index (FQI) was calculated following the methods described by the Michigan Department of Natural Resources (2001). The procedure for calculating FQI is a standardized, repeatable method of determining the floristic quality of an area based on the native plants found at the site. A coefficient of conservatism (C) has been assigned to each species based on the probability that the species would be found in Michigan during pre-settlement times. The C values range from zero to ten, with zero being associated with the highest disturbance tolerance and least fidelity to pre-settlement vegetation. Plants with a C value of ten are being associated with the least disturbance tolerance and greatest fidelity to pre-settlement conditions. The mathematical formula for determining the FQI for a site is based on the C values for the plants at the site and the species richness at the site.

FIGURE 4. *Sarracenia purpurea* in bog area, June 18, 2008. Photograph by Kathleen Baker.

FIGURE 5. *Calopogon tuberosus* in fen area, June 19, 2008. Photograph by Kathleen Baker.

FIGURE 6. Red maple swamp forest, June 18, 2008. Photograph by Kathleen Baker.

TABLE 1. Species with a Coefficient of Conservation Value 10

Species Name	Common Name	Location	Wetland
Woodwardia virginica (L.) Smith	Giant Chain Fern	Bog/fen/tamaracks	OBL
Carex chordorrhiza Ehrh. ex L. f.		Edge of bog	FACW+
Carex rostrata Stokes		Bog, emergent marsh	OBL
Pogonia ophioglossoides (L.) Ker-Gawl	Rose Pogonia	Bog/fen/tamaracks	OBL
Cardamine pratensis L.	Cuckoo-flower	Bog/fen/tamaracks	OBL
Sarracenia purpurea L.	Pitcher-plant	Bog/fen/tamaracks	OBL
Conopholis americana (L.) Wallr.	Squaw-root	Red maple swamp	UPL
Utricularia minor L.	Lesser Bladderwort	Marsh/bog/fen interface	OBL

RESULTS

The study area yielded a total of 292 species of vascular plants (Appendix 1). These species represented 81 families and 180 genera. The most species-rich families were Asteraceae (40), Rosaceae (25), Cyperaceae (24), Poaceae (16) and Fabaceae (12). Nine genera contained five or more species including: *Carex* (16); *Salix* (7); *Polygonum* (6), *Aster*, *Galium*, *Rumex*, *Solidago*, and *Trifolium* (5). Of the 292 species eight were pteridophytes, four were gymnosperms, 58 were monocots and 222 were dicots. One of the species, *Carex chordorrhiza,* is a new record for Kalamazoo County. About 20 percent of the species, 60 of the 292, were exotics while the rest were native species. The Asteraceae contained the greatest number of exotic species (12), with eight in Poaceae and seven in Fabaceae.

The FQI value, based on 232 native species, was 68. Eight species had a C value of 10, indicating that they are almost always restricted to a presettlement remnant (Table 1). Seven of the eight species were found in conjunction with seepage bog/fen ingrading with marsh and tamarack swamp and are considered obligate or facultative wetland species (Michigan DNR 2001). Only one of the species was an upland species, *Conopholis americana* found in red maple swamp forest.

DISCUSSION

In Michigan, most of the remaining undeveloped land has minimal significance from a natural quality perspective (Michigan DNR 2001). It is significant that a new county record can be found in a county as thoroughly studied as Kalamazoo County.

Small tracts of privately held lands with diverse habitats and plant communities are important to the preservation of Michigan's native biodiversity. These tracts can be more isolated and less susceptible to introduced species than public lands. In the case of the studied tract, the tamarack swamp and bog/fen areas are rarely visited by humans or domesticated animals. In addition to being surrounded by agricultural land, the deep moat and tenuous structure of the mat dis-

courage visitors. Results from this study site show relatively low influx of introduced species with an FQI of 68. Areas that register above 50 on the FQI in Michigan are considered "extremely rare" (Michigan DNR 2001). However, the FQI does not incorporate evenness or abundance of species. Species that are most indicative of undisturbed habitats (high C values) are relegated to small patches within the overall matrix of the tract.

Repeated floristic inventories of privately owned, relatively small plots can be a useful way of documenting the effects of changing faunal populations, including increasing deer herbivory and turkey populations, invasive species, and climate change. It is hoped that the "extremely rare" conditions present at the study site persist and that the area will remain undisturbed.

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APPENDIX 1. Vascular flora of privately owned wetlands, Pavilion Township, Kalamazoo County, Michigan.

The list of flora is arranged synoptically according to Voss (1972; 1985; 1996), and the sequence of taxa within families is alphabetical. Nomenclature, in general, follows Voss (1972; 1985; 1996) and Flora of North America (1993). In an effort to make the checklist more useful to the general public, vernacular names are given whenever possible, primarily following Voss (1972; 1985; 1996). Voucher numbers for C. Elizabeth Whately follow common name of species in parentheses.

PTERIDOPHYTES

LYCOPODIACEAE (Club-moss Family)
Diphasiastrum digitatum (Dillenius ex A. Braun) Holub; Southern Running-pine. (4)
EQUISETACEAE (Horsetail Family)
Equisetum arvense L.; Common Horsetail. (131)
x *litorale* Kuhlewein ex Ruprecht. (49)
DRYOPTERIDACEAE (Wood Fern Family)
Dryopteris clintoniana (D.C. Eaton) Dowell; Clinton's wood fern. (132)
OSMUNDACEAE (Royal Fern Family)
Osmunda cinnamomea L.; Cinnamon Fern. (78)
Osmunda regalis L.; Royal Fern. (154)
THELYPTERIDACEAE (Marsh Fern Family)
Thelypteris palustris Schott; Marsh Fern. (271)
BLECHNACEAE
Woodwardia virginica (L.) Smith; Virginia Chain Fern. (224)

GYMNOSPERMS

PINACEAE (Pine Family)
Larix laricina (DuRoi) K. Koch; Tamarack. (143)
Pinus sylvestris L.; Scotch Pine. (5)
Pseudotsuga menziesii (Mirbel) Franco; Douglas-fir. (195)
CUPRESSACEAE (Cypress Family)
Juniperus communis L.; Common Juniper. (46)

MONOCOTS

TYPHACEAE (Cat-tail Family)
Typha latifolia L.; Common Cattail. (184)
SPARGANIACEAE (Bur-reed Family)
Sparganium americanum Nutt. (183)
Sparganium chlorocarpum Rydb.; European Bur-reed. (253)
ALISMATACEAE (Water-plantain Family)
Alisma plantago-aquatica L.; Water-plantain. (220)
Sagittaria latifolia Willd.; Arrowhead, Wapato. (225)
POACEAE (Grass Family)
Agropyron repens (L.) Beauv.; Quack Grass. (307)
Agrostis perennans (Walter) Tuckerman; Autumn Bent Grass. (136)
Andropogon virginicus L.; Broom-sedge. (297)
Bromus commutatus Schrader; Hairy Chess. (91)
Bromus mollis L.; Soft Chess. (107)
Cinna arundinaceae L.; Wood Reedgrass. (294)
Dactylis glomerata L.; Orchard Grass. (100)

Glyceria striata (Lam.) Hitchc.; Fowl Manna Grass. (134)
Hystrix patula Moench; Bottlebrush Grass. (243)
Panicum rigidulum Nees. (257)
Phalaris arundinacea L.; Reed Canary Grass. (140)
Phleum pratense L.; Timothy. (106)
Phragmites australis (Cav.) Steudel; Reed. (254)
Poa annua L.; Annual Bluegrass. (37)
Poa compressa L.; Canada Bluegrass. (166)
Poa pratensis L.; Kentucky Bluegrass. (95)

CYPERACEAE (Sedge Family)
Carex amphibola Steudel. (175)
Carex bebbii (Bailey) Fern. (152)
Carex canescens L. (81)
Carex chordorrhiza Ehrh. ex L. f. (76)
Carex comosa Boott.; Bristly Sedge. (150)
Carex frankii Kunth. (182)
Carex lasiocarpa Ehrh. (82, 153)
Carex laxiflora Lam. (41)
Carex lupulina Willd. (114)
Carex muhlenbergii Willd. (51)
Carex rosea Willd. (135)
Carex rostrata Stokes. (80, 181)
Carex swanii (Fern.) Mack. (125)
Carex tribuloides Wahlenb.; Blunt Broom Sedge (231)
Carex trisperma Dewey. (70)
Carex vulpinoidea Michx. (99)
Cyperus engelmannii Steudal.; Fragrant Flatsedge. (281)
Dulichium arundinaceum (L.) Britt.; Three-way Sedge. (228)
Eleocharis smallii Britton. (79)
Eriophorum virginicum L.; Tawny Cotton-grass. (230)
Eriophorum viridicarinatum (Engelm.) Fern. (229)
Scirpus atrovirens Willd. (167)
Scirpus cyperinus (L.) Kunth; Wool-grass. (284)
Scirpus validus Vahl; Softstem Bulrush. (187)

ARACEAE (Arum Family)
Arisaema triphyllum (L.) Schott; Jack-in-the-pulpit. (84)

LEMNACEAE (Duckweed Family)
Lemna minor L.; Duckweed.

PONTEDERIACEAE (Pickerel-weed Family)
Pontederia cordata L.; Pickerel-weed. (245)

JUNCACEAE (Rush Family)
Juncus canadensis J. Gay. (227)
Juncus dudleyi Wieg. (111)
Juncus effusus L.; Soft Rush. (113)
Juncus tenuis Willd.; Path Rush. (174)
Luzula multiflora (Retz.) Lej. (34, 57)

LILIACEAE (Lily Family)
Allium vineale L.; Field Garlic. (120)

IRIDACEAE (Iris Family)
Iris virginica L.; Southern Blue Flag. (103)

ORCHIDACEAE (Orchid Family)
Calopogon tuberosus (L.) BSP.; Grass-pink. (149)
Cypripedium acaule Aiton; Moccasin Flower; Pink or Stemless Lady-slipper. (74)
Platanthera clavellata (Michx.) Luer; Green Woodland Orchid. (263)
Pogonia ophioglossoides (L.) Ker-Gawl; Rose Pogonia. (148)
Spiranthes cernua (L.) Richard; Nodding Ladies'-tresses. (283)

DICOTS

SALICACEAE (Willow Family)
Populus tremuloides Michaux; Quaking Aspen. (2, 14)
Salix bebbiana Sarg.; Long-beaked Willow. (28)
Salix discolor Muhl.; Large Pussy Willow. (3, 9)
Salix eriocephala Michaux. (1, 31)
Salix lucida Muhl.; Shining Willow. (23)
Salix nigra Marsh.; Black Willow. (270)
Salix petiolaris Smith; Slender Willow. (25)
Salix sericea Marsh.; Silky Willow. (11, 19)
JUGLANDACEAE (Walnut Family)
Carya glabra (Miller) Sweet; Pignut Hickory. (310)
Carya ovata (Miller) K. Koch; Shagbark Hickory. (191)
BETULACEAE
Betula pumila L.; Swamp Birch. (29, 142)
Corylus americana Walter; Hazelnut. (193)
FAGACEAE (Beech Family)
Quercus alba L.; White Oak. (298)
Quercus palustris Muenchh.; Pin Oak. (296)
Quercus rubra L.; Red Oak. (205)
Quercus velutina Lam.; Black Oak. (293)
ULMACEAE (Elm Family)
Ulmus americana L.; American or White Elm. (202)
MORACEAE (Mulberry Family)
Morus alba L.; Russian or White Mulberry. (194)
URTICACEAE (Nettle Family)
Boehmeria cylindrica (L.) Sw.; Bog-hemp; False Nettle. (210)
Urtica dioica L.; Stinging Nettle. (214)
POLYGONACEAE (Buckwheat Family)
Polygonum amphibium L.; Water Smartweed. (250)
Polygonum hydropiperoides Michx.; Mild Water-pepper. (165)
Polygonum pensylvanicum L.; Pinkweed; Bigseed Smartweed. (178, 222)
Polygonum persicaria L.; Heart's-ease; Lady's-thumb. (256)
Polygonum sagittatum L.; Tear-thumb. (232)
Polygonum virginianum L.; Jumpseed. (255)
Rumex acetosella L.; Sheep Sorrel. (32)
Rumex altissimus Wood; Pale Dock. (116)
Rumex crispus L.; Curly Dock. (251)
Rumex obtusifolius L.; Bitter Dock. (213)
Rumex orbiculatus A. Gray; Great Water Dock. (288)
PORTULACACEAE (Purslane Family)
Claytonia virginica L.; Spring Beauty. (15)
CARYOPHYLLACEAE (Pink Family)
Cerastium fontanum Baumg.; Mouse-ear Chickweed. (43)
Dianthus armeria L.; Deptford Pink. (207)
Silene pratensis (Rafn) Godron & Gren.; White Campion. (62)
Stellaria media (L.) Vill.; Common Chickweeed. (12)
CERATOPHYLLACEAE (Hornwort Family)
Ceratophyllum demersum L.; Hornwort. (217)
NYMPHACEAE (Water-lily Family)
Nuphar advena (Ait.) Ait. f.; Yellow Spatterdock. (221)
RANUNCULACEAE (Buttercup Family)
Actaea pachypoda Ell.; White Baneberry; Doll's-eyes. (200)
Anemone cylindrica A. Gray; Thimbleweed. (203)
Anemone virginiana L.; Thimbleweed. (164)
Anemonella thalictroides (L.) Spach; Rue-anemone. (38)
Caltha palustris L.; Marsh-marigold. (36)

Ranunculus abortivus L.;Small-flowered Buttercup. (16)
Ranunculus recurvatus Poiret; Hooked Crowfoot. (212)
Ranunculus sceleratus L.; Cursed Crowfoot. (186)
BERBERIDACEAE (Barberry Family)
Podophyllum peltatum L.; May-apple. (52)
LAURACEAE (Laurel Family)
Lindera benzoin (L.) Blume; Spicebush. (300)
Sassafras albidum (Nutt.) Nees; Sassafras. (123)
BRASSICACEAE (Mustard Family)
Arabidopsis thaliana (L.) Heynh.; Mouse-ear Cress. (13)
Barbarea vulgaris R. Br.; Yellow Rocket. (10)
Cardamine bulbosa (Muhl.) BSP; Spring Cress. (42)
Cardamine pratensis L.; Cuckoo-flower. (73)
Lepidium campestre (L.) R. Br.; Field Peppergrass. (60)
SARRACENIACEAE (Pitcher-plant Family)
Sarracenia purpurea L.; Pitcher-plant. (144)
DROSERACEAE (Sundew Family)
Drosera rotundifolia L.; Round-leaved Sundew. (71)
SAXIFRAGACEAE (Saxifrage Family)
Penthorum sedoides L. (279)
GROSSULARIACEAE (Gooseberry Family)
Ribes cynosbati L.; Wild Gooseberry. (66)
ROSACEAE (Rose Family)
Agrimonia gryposepala Wallr.; Tall Agrimony. (211)
Agrimonia pubescens Wallr.; Soft Agrimony. (170)
Aronia prunifolia (Marsh.) Rehd.; Chokeberry. (70)
Crataegus pedicellata Sarg. (54)
Fragaria virginiana Miller; Wild Strawberry. (35)
Geum canadense Jacq.; White Avens. (133)
Geum vernum (Raf.) T. & G. (39)
Malus coronaria (L.) Miller; Wild, American, or Sweet Crab. (117, 309)
Malus pumila Miller; Apple. (22)
Potentilla norvegica L.; Rough Cinquefoil. (63)
Potentilla palustris (L.) Scop.; Marsh Cinquefoil. (141)
Potentilla recta L.; Rough-fruited Cinquefoil. (118)
Potentilla simplex Michaux; Common Cinquefoil. (89)
Prunus pensylvanica L. f.; Pin Cherry. (33)
Prunus serotina Ehrh.; Wild Black Cherry. (50)
Rosa carolina L.; Pasture Rose. (104)
Rosa multiflora Murray; Multiflora Rose. (158)
Rosa palustris Marsh.; Swamp Rose. (180)
Rubus allegheniensis Porter; Common Blackberry. (306)
Rubus flagellaris Willd.; Northern Dewberry. (67)
Rubus occidentalis L.; Black Raspberry. (97)
Rubus pensylvanicus Poiret. (98)
Sorbus aucuparia L.; European Mountain-ash. (204)
Spiraea alba DuRoi; Meadowsweet. (138)
Spiraea tomentosa L.; Steeplebush. (146, 241)
FABACEAE
Apios americana Medic.; Groundnut. (260)
Desmodium marilandicum (L.) DC.; Smooth Small-leaf Tick Trefoil. (238)
Desmodium paniculatum (L.) DC; Panicled Tick Trefoil. (240)
Lathyrus palustris L.; Marsh Pea; Vetchling. (163)
Lespedeza intermedia (Watson) Britton. (242)
Lespedeza violacea (L.) Pers. (198)
Medicago lupulina L.; Black Medic. (92)
Trifolium campestre Schreber; Low Hop Clover. (105)

Trifolium dubium Sibth.; Little Hop Clover. (59)
Trifolium hybridum L.; Alsike Clover. (102)
Trifolium pratense L.; Red Clover. (93)
Trifolium repens L.; White Clover. (94)
OXALIDACEAE (Wood-sorrel Family)
Oxalis stricta L.; Wood-sorrel. (58)
GERANIACEAE (Geranium Family)
Geranium maculatum L.; Wild Geranium. (53)
Geranium robertianum L.; Herb Robert. (64)
POLYGALACEAE (Milkwort Family)
Polygala sanguinea L.; Purple Milkwort. (246)
EUPHORBIACEAE (Spurge Family)
Euphorbia corollata L.; Flowering Spurge. (124)
ANACARDIACEAE (Cashew Family)
Rhus typhina L.; Staghorn Sumac. (129)
Toxicodendron radicans (L.) Ktze.; Poison Ivy. (Photo Documentation)
Toxicodendron vernix (L.) Ktze.; Poison Sumac. (Photo Documentation)
AQUAFOLIACEAE (Holly Family)
Ilex verticillata (L.) Gray; Winterberry. (289)
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NOTEWORTHY COLLECTION

MICHIGAN

Arctium lappa L. (Asteraceae). Great Burdock.

Previous knowledge. A native of Eurasia, *Arctium lappa* was brought to North America as a medicinal plant by early European settlers (Hanrahan & Frey 2005). Its range in North America includes 31 states and 7 provinces (USDA 2009). In the Great Lakes area the species is known in Wisconsin, Michigan, Illinois, Indiana, Ohio, Pennsylvania, New York, and Ontario (USDA 2009).

Arctium lappa occurs in waste places, roadsides, fields and forest clearings to 2,200 m in elevation (Keil 2006). A search of *A. lappa* on the internet produced numerous websites devoted to medicinal and edible information on this species. Were not for its potential for invasiveness (similar to *A. minus*), *A. lappa* might be worthy as a source for commercial bird seed.

Significance of the report. Voss (1996) states of *A. lappa*, "Evidently not common (and perhaps no longer found) in Michigan." This station represents the northernmost known locality in Michigan. The Wexford County site (Figure 1)

FIGURE 1. Arctium lappa and general habitat at site of Wexford County collection. Photo taken 21 September 2008.

FIGURE 2. Typical seed heads of Arctium lappa and A. minus (left and right) at site of Wexford County collection. Photo taken 21 September 2008.

joins four other counties with records: Lenawee, Monroe, Van Buren, and Washtenaw (Anton A. Reznicek, pers. comm. 11 March 2009) all in southernmost Michigan. The first specimen was taken by Herbert F. Gates in Van Buren County 24 August 1906. The next specimen was taken by Oliver A. Farwell in Monroe County 22 August 1923. The Washtenaw County specimen was taken by W.O. Moore 29 July 1956. Subsequent to the publication of Vol. 3 of Michigan Flora (Voss 1996), a specimen was taken by Robert W. Smith in Lenawee County 22 August 1998 (Anton A. Reznicek, pers. comm. 11 March 2009).

Diagnostic characters. *Arctium lappa* is a biennial herb that grows to 3.0 m in height. In contrast to the hollow lower petioles of *A. minus*, the petioles of *A. lappa* are mostly solid (Gleason & Cronquist 1991). The floral heads of *A. lappa* occur in corymbiform clusters as opposed to racemiform or paniculiform clusters in *A. minus* (Keil 2006). The individual floral heads of *A. lappa* are typically 2.5–4 cm wide vs. 1.5–2.5 cm wide in *A. minus*, whereas the achenes are 6–7 mm long in the former vs. 4–5.5 mm long in the latter (Gleason & Cronquist 1991) (Figures 2 and 3). The blooming period is recorded as July through October (Keil 2006). Overall, the impression of this species in the field is that of *A. minus* "on steroids."

Specimen citation. WEXFORD CO.: Along the south side of County Road 34 (FR 7520) at its intersection with FR 7258 (at the southwest corner), Township

FIGURE 3. Pale immature seeds of Arctium lappa and smaller darker mature seeds of A. minus (top and bottom) at site of Wexford County collection. Photo taken 21 September 2008.

22 N, Range 11 W, Section 29 (NE ¼ of the SE ¼) in Manistee National Forest, 16 September 2008, *Dister 7* (MICH). There were approximately 20 plants in fruiting condition (tallest at 1.6 m) and another 20 or more in non-fruiting condition (*i.e.*, 1st year basal rosettes); the population occurs along a 16.1 m length of roadside (6.1 m wide on the east and 0.9 m wide on the west). The habitat is a roadside corridor opening that lies below a dirt road (CR 34) and adjacent to a red pine (*Pinus resinosa*) plantation. Associated species include *Ambrosia artemisiifolia*, *Hypericum perforatum*, *Oxalis* sp., *Phleum pratense*, *Pilea pumila*, *Plantago rugelii*, *Polygonum punctatum*, *Pteridium aquilinum* and *Rubus strigosus, A. minus*, and possible hybrids with *A. lappa*, occur on both sides of CR 34.

Lastly, this population of *A. lappa* was destroyed by the U.S. Forest Service in September 2009 as a precautionary measure.

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——David C. Dister
2365 North Lakeshore Drive
Ludington, MI 49431
david.dister@gmail.com

NOTEWORTHY COLLECTION

MICHIGAN

Dasistoma macrophylla (Nutt.) Raf. (Scrophulariaceae). Mullein foxglove.

Previous knowledge. Dasistoma macrophylla is a large forb of oak savannas, open deciduous forests, and forest openings along riverbanks (Voss 1996, MNFI 2007). As with several other species in Scrophulariaceae, it is hemiparasitic on a variety of tree species, including *Ulmus americana*, *Acer saccharum*, *A. saccharinum*, and *Quercus* spp. (Musselman and Mann 1977). A native of North America, *D. Macrophylla* is known from Pennsylvania to Nebraska and south from Georgia to Texas. It reaches the northern edge of its known range in Wisconsin and Michigan (USDA NRCS 2010). Prior to this collection, only two occurrences of *D. Macrophylla* were known in Michigan, one from a floodplain forest in Ionia County observed in 2003 (MNFI 2007) and the other a historical record from Berrien County that has more recently been confirmed along the St. Joseph River (Voss 1996, Anton Rezincek, pers. comm.). The nearest records outside Michigan are from Lucas and Fulton Counties in northwest Ohio (USDA NRCS 2010). Common synonyms of this species are *Seymeria macrophylla* Nutt. and *Afzelia macrophylla* (Nutt.) Kuntze; it is also considered part of Orobanchaceae (USDA NRCS 2010).

Significance of the report. Although *D. macrophylla* is considered apparently secure (G4), it is rare throughout much of its range and is endangered in Michigan (Morris et al. 1993, MNFI 2007). This occurrence fills a gap in our knowledge of the geographic extent of the species and helps confirm our understanding of the habitat requirements of the species. Also, the isolation of this occurrence of *D. macrophylla* relative to others raises interesting questions and possible research opportunities on the genetic, reproductive, and dispersal ecology of rare species in very disjointed populations.

Diagnostic characteristics. Dasistoma macrophylla is a large forb with opposite, deeply lobed leaves that become smaller and entire near the apex, and sessile, tubular, yellow flowers (Figure 1). It is the only *Dasistoma* species known in Michigan. It is distinguished from members of the closely-related genus *Aureolaria* by having a corolla about 1.5 cm long, nearly sessile flowers, and calyx with eglandular pubescence (Voss 1996). In particular, *D. macrophylla* is distinguished from *A. virginica*, a somewhat similar-looking species, by having smaller flowers, a shorter pedicel, and a smaller capsule (Voss 1996).

Specimen citation. Wayne County: Oakwoods Metropark, 3 miles west of Flat Rock, Michigan, 0.8 miles south of Huron River Drive, 2 miles east of US 275. On 18 August 2009, 97 individuals were observed in scattered clumps along a degraded riverbank with an open canopy. Associated species: *Quercus rubra*, *Q. alba*, *Cercis canadensis*, *Cornus drummondii*, *Toxicodendron radicans*, *Geranium maculatum*, *Solidago canadensis*, *Aster lateriflorus*., *Smilacina racemosa*, *Rhamnus cathartica*, *Elaeagnus umbellata*. A specimen was originally collected

FIGURE 1: Photo of *Dasistoma macrophylla* flowering branch at Oakwoods Metropark, Wayne County, Michigan (Photo by Justin Heslinga).

by Bill Brodovich on 1 August 2008 and deposited in the University of Michigan Herbarium (Brodovich 1439).

ACKNOWLEDGEMENTS

I would like to thank Bill Brodovich for originally notifying the Metroparks of this remarkable occurrence, Mike Penskar and Tony Reznicek for providing information on *D. macrophylla* records in Michigan, and an anonymous reviewer for offering valuable suggestions which improved this manuscript.

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——Justin L. Heslinga
Huron-Clinton Metroparks
13000 High Ridge Drive
Brighton, MI 48114
justin.heslinga@gmail.com

New York Botanical Garden Library
3 5185 00269 4543

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On the cover: Osmunda regalis *(Royal fern) leaves unfurling, April 30, 2008. Photography by Kathleen Baker.*

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SOLIDAGO VOSSII (ASTERACEAE), A NEW SPECIES OF GOLDENROD FROM NORTHERN MICHIGAN

Pamela J. Laureto
Department of Biological Sciences
Grand Rapids Community College
143 Bostwick NE
Grand Rapids, Michigan 49503
plaureto@grcc.edu

James S. Pringle
Royal Botanical Gardens
P.O. Box 399, Hamilton, ON
Canada L8N 3H8
jpringle@rbg.ca

ABSTRACT

A new species of Asteraceae from Michigan U.S.A., *Solidago vossii* J. S. Pringle & P. J. Laureto, is described based on morphology, habitat, native range, and genome size. *Solidago vossii* is apparently endangered as it is known only from a northern wet prairie/pine barrens complex within a 2.25 square mile area near the border of southern Crawford and Kalkaska counties in northern Michigan. Morphologically, *S. vossii* is most similar to *S. houghtonii*, but differs in several features. The morphological features of the two species are compared and their phylogenetic relationship discussed. Chromosome counts indicate *S. vossii* is octoploid ($2n = 8x = 72$) and flow cytometry data support an octoploid genome size for plants from throughout the known range.

KEY WORDS: Asteraceae, chromosome counts, flow cytometry, new species, *Solidago vossii*

INTRODUCTION

For botanists, both professional and amateur, goldenrods in the genus *Solidago* L. are often difficult to identify to species. There are approximately 100 species of goldenrod in North America, with the greatest number of these occurring in eastern North America (Semple and Cook 2006), where they are an important component of the autumn flora. Some species, such as *S. altissima* L. (late goldenrod) and *S. nemoralis* Aiton (gray goldenrod), are ubiquitous and often occur in such dense populations that they are commonly described as "weeds". However, many other species are sparsely distributed throughout their native range, and four species, *S. albopilosa* E. L. Braun (white-haired goldenrod), *S. houghtonii* A. Gray (Houghton's goldenrod), *S. shortii* Torrey & A. Gray (Short's goldenrod), and *S. spithamaea* M A. Curtis *ex* A. Gray (Blue Ridge goldenrod), have such restricted distributions that they are federally listed as either "Threatened" or "Endangered" (USFWS 1988a; USFWS 1988b; USFWS 1985b; USFWS 1985a respectively).

Semple and Cook (2006) presented a taxonomic overview of the genus *Solidago* in which they recognized two sections, section *Solidago*, comprising 11 subsections, and section *Ptarmicoidei* (House) Semple and Gandhi. Section *Ptarmicoidei* currently includes six species that are easily distinguished from the other goldenrods by their corymboid (flat-topped) inflorescences. This section has its center of distribution in the Great Lakes region, with five of its six species

(*S. houghtonii*, *S. ohioensis* Riddell, *S. ptarmicoides* (Torrey & A. Gray) B. Boivin, *S. riddellii* Frank, and *S. rigida* L.) occurring in the state of Michigan.

Although a specimen had been collected at the site as early as 1933, Edward G. Voss first noted in the 1960s that a goldenrod population on the sandy shores of the tiny Howes Lake in Crawford County, Michigan, resembled *Solidago houghtonii* and reported it as that species (in Guire and Voss 1963). James S. Pringle visited this site and observed these plants in the early 1970s. From morphological observations and a chromosome count he believed that the Howes Lake plants were distinct from true *S. houghtonii*, and suggested these plants might have a hybrid origin different from that of *S. houghtonii*. Since Pringle's observations were made, additional occurrences have been discovered, and the population is now believed to be contiguous within an area of approximately 2.25 square miles (Fig. 1).

Recently, Laureto (2010; Laureto and Barkman, in press) tested Pringle's hypotheses regarding the hybrid origin of entities called *Solidago houghtonii* including plants from throughout the geographic range of the species (Genesee Co. NY, Bruce Peninsula ON Canada, Mackinaw Co. MI, and Crawford Co. MI). True *S. houghtonii* is a hexaploid ($2n = 6x = 54$) species of hybrid origin (Laureto 2010; Laureto and Barkman, in press). Laureto's molecular phylogenetic analysis of the hybrid origin of plants called *S. houghtonii* confirmed that the Crawford County plants are of hybrid origin and suggested that these plants were likely derived from the hexaploid *S. houghtonii* because they share the same parental taxa with true *S. houghtonii*. Chromosome count and flow cytometry data presented here indicate the Crawford County plants are nevertheless distinct from *S. houghtonii*. They are described here as a new species, *Solidago vossii* J. S. Pringle and P. J. Laureto.

MATERIALS AND METHODS

Plant Material

Thirty-five specimens of *Solidago vossii* were used for the description of the new species. Thirty plants were observed in the field and five were herbarium specimens. The primary diagnostic characters are compared with those of *S. houghtonii* (Table 1). Morphological data were calculated as follows: Each examined specimen represents one evaluation of the number of heads and all non-numerical characters and five measurements for all numerical characters (i.e. florets, leaves, phyllaries).

A total of eight individual *Solidago vossii* plants were collected, including achenes, from areas throughout the 2.25 square mile range of this species. These were used for determination of ploidy number by chromosome counting and flow cytometry methods described below. Plants and achenes were collected under Michigan Department of Natural Resources Threatened and Endangered Species permits #1855 and #1928. Voucher specimens are deposited in the Hanes Herbarium, Western Michigan University (WMU).

Chromosome Counts

Chromosomes counts were made from root-tip meristems of four field-collected *Solidago vossii* plants which were grown in the greenhouse at Grand Rapids Community College. Following the protocol of L. Michael Hill (2009), root tips were removed from plants and pre-treated in 0.002 M 8-hydroxyquinoline for 5 hours at 15°C and then fixed for 15 minutes in acetic acid-alcohol (1:3) which was warmed to 60°C. The fixed root tips were then hydrolyzed in 1 N HCl for 30 minutes at 60°C and stained with 1% aceto-orcein for 5 minutes. Mayer's albumen was applied to a cover-slip, which was placed over the preparation, and the root tips were squashed in order to separate the cells

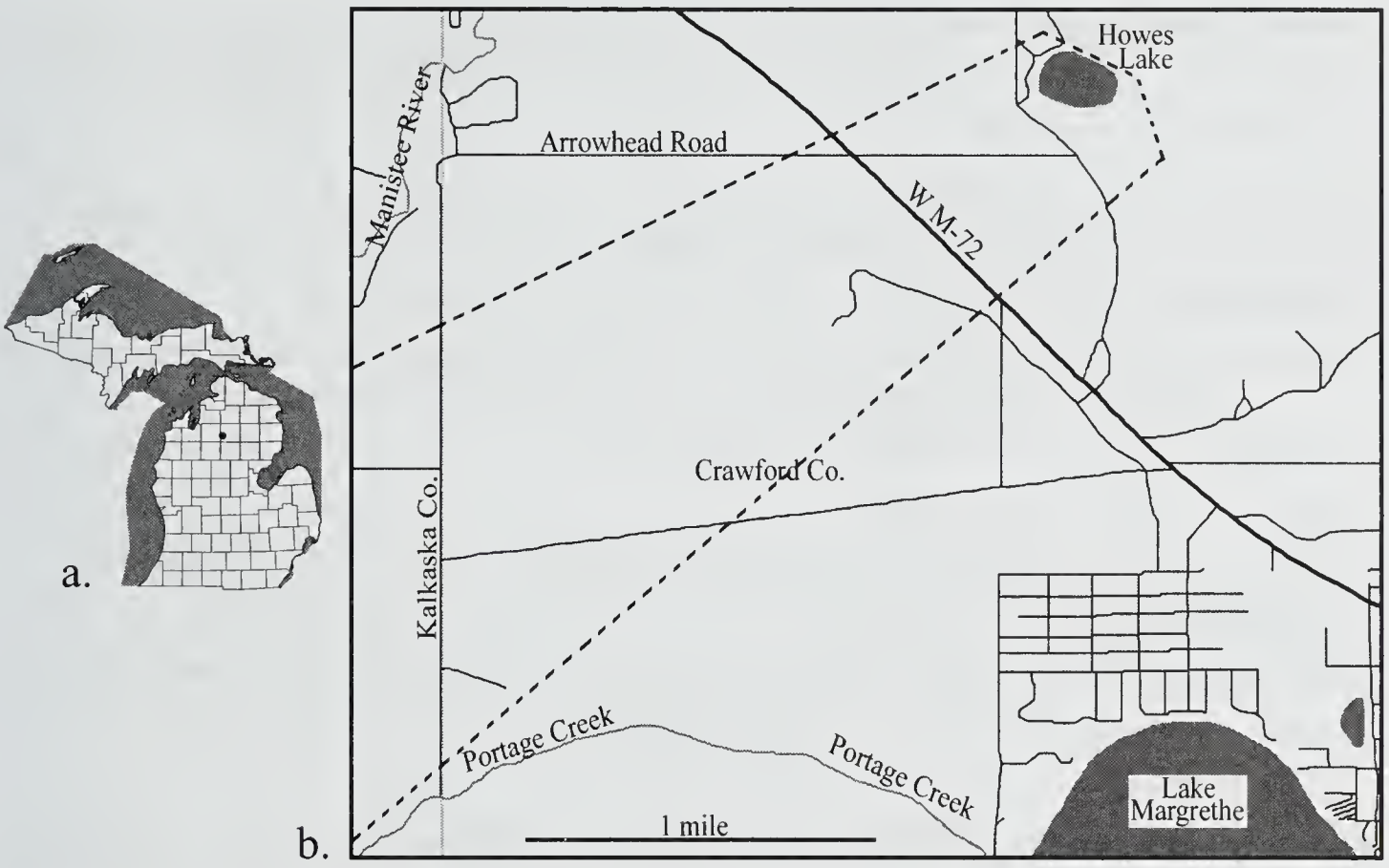

FIGURE 1. a. Map of Michigan showing location of *Solidago vossii* population. Map modified from Benbennick 2007. b. The location of *S. vossii* in southern Crawford and Kalkaska counties is outlined. A small colony of a few individuals occurs on the east side of Lake Margrethe at the entrance to Camp Grayling (not shown). Map modified from U.S. Census Bureau 2010.

and make the chromosomes more visible. After removing the cover-slip, the tissue was dried by passing it through the following five solutions: 1:1 ethyl alcohol-glacial acetic acid, 3:1 ethyl alcohol-glacial acetic acid, 9:1 ethyl alcohol-glacial acetic acid, 95% ethyl alcohol, 95% ethyl alcohol (second change). The cover-slip/root-tip squash was permanently fixed to a clean slide using a drop of Euparal. From one or more slides, five metaphase cells were inspected for each plant. Chromosome counts were performed at 1000× magnification using a Nikon Microphot FXA microscope (Nikon Corp.) with differential interference contrast optics in place.

Flow Cytometry

Flow cytometry (FCM) is a rapid and robust analytical tool that allows accurate determination of DNA content for a large number of nuclei (Kron et al. 2007). Originally it was used to identify and characterize cancerous cells, but today it is revolutionizing such fields as ecology, evolutionary biology, and systematics (Kron et al. 2007). Since the method allows for the estimation of the nuclear DNA content of a large number of nuclei, it is being used to provide information about the ploidy level of individuals and the organismal composition of populations (Suda et al. 2007). The gathering of such information has historically been time-consuming which meant that the DNA content of individuals within a population was estimated from just a few individuals. FCM has made it possible to gather information on genome size and ploidy level for large numbers of individuals in a relatively short amount of time. FCM data provide strong support for the determination of ploidy level within a population especially when combined with data from chromosome counts (Suda et al. 2007).

FCM quantifies the intensity of light signals by individual nuclei that have been stained with a DNA-specific fluorochrome and excited by a laser beam. As the nuclei pass single-file at high speed through the illuminating beam they fluoresce and scatter light. These light signals are used to provide an estimate of the amount of DNA in the nuclei which is then quantified using known standards (Kron et al. 2007).

FCM analysis was performed using fresh young leaves from 23 *Solidago vossii* seedlings which

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TABLE 1. Comparison of *Solidago vossii* and *S. houghtonii* diagnostic characters.

Features	Solidago vossii	Solidago houghtonii
Growth habit	single	single or cespitose
Stems	4–7+ dm tall	3–5 dm tall
Basal leaves	sparsely to regularly serrulate	entire
Number of heads	20 to 60	5 to 50
Involucre	6.0–9.0 mm long; 18 to 24 phyllaries	5.0–8.0 mm long; 15 to 18 phyllaries
Ray florets	6 to 8; lamina 1.2–2.0 mm wide	6 to 12; lamina 0.5–0.6 mm wide
Achene	1.8–2.5 mm	1.4–1.8 mm
Pappus	bristles of various lengths; not clavate	blistles of equal length; clavate
Chromosome number	$2n = 72$; octoploid	$2n = 54$; hexaploid
Distribution	localized in wet prairie in Crawford and Kalkaska counties	shorelines of northern Lakes Michigan and Huron

had been grown in the Grand Rapids Community College greenhouse. The analyses were done by Paul Kron in the lab of Dr. Brian Husband, Department of Integrative Biology, University of Guelph. For each sample, approximately 2 × 2 cm of leaf tissue from *S. vossii* and an internal standard, *Glycine max* 'Polanka', were co-chopped with a new razor blade in 0.5 ml ice-cold modified de Laat buffer (Kron and Husband 2009) with 50 µg/ml propidium iodide, a DNA-specific fluorochrome, and 50 µg/ml RNAse. After 20–90 minutes of staining time the suspension of released nuclei from each sample was filtered through a 30 µm filter into a labeled test tube. The nuclear DNA content of the internal standard *Glycine max* 'Polanka' is reported to be 2.5 pg/2C (Doležel et al. 1994; Doležel et al. 2007), where pg represents the amount of nuclear DNA expressed in the mass units picograms and 2C (2C-value) refers to the complete somatic DNA content regardless of ploidy (Kron et al. 2007).

Samples were run on a BD FACSCalibur flow cytometer (Becton Dickinson) at low or medium pressure (depending on nuclei number) for up to 5 minutes. Data were acquired using CellQuest Pro software (BD Biosciences). In FCM the measured parameter is the fluorescence of isolated nuclei. The fluorescence intensity of the nuclei is recorded as peaks on a histogram. When the genome size of the internal standard is known, the absolute DNA content, in picograms, for the test nuclei can be estimated from the relative fluorescence values (Kron et al. 2007). The mean fluorescence of the *Solidago* peak was divided by the mean fluorescence of the *Glycine max* peak, multiplied by 2.5 pg/2C, and expressed in DNA pg/2C. All samples were analyzed with a 256 channel scale using Modfit software (Verity Software) to estimate the fluorescence ratio, the coefficients of variation (CV), and the number of nuclei present. According to Greilhuber et al. (2007) a CV ≤5 is recommended for genome size estimation whereas a CV ≤7 is regarded as acceptable for ploidy determination. The number of nuclei present is recommended to be ≥1300 for genome size estimations but much lower numbers are generally considered to be acceptable for ploidy determinations.

The DNA pg/2C values for the 23 *Solidago vossii* samples were compared to the mean DNA pg/2C value of *Solidago hispida* Muhlenberg ex Willdenow, a known diploid goldenrod (Jess Peirson, unpublished data).

RESULTS AND DISCUSSION

Diagnosis

Solidago vossii J. S. Pringle et P. J. Laureto, sp. nov.

Solidagini houghtonii similis sed chromosomatum numero $2n=8x=72$ foliis

basalibus serratulis capitulis phyllariis pluribus ligulisque latioribus et acheniis majoribus pappi setis inaequalibus non clavatis differens.

Type

Holotype: U.S.A., Michigan, Crawford Co., N shore of Howe's Lake, ca. 6 km W of Grayling, Sec. 32, T27N R4W, *Voss 11008*, 14 August 1992, MICH; Isotypes: BLH, MSC, TRT, UMBS; Paratypes (all from the same locality): *Somerville 1933*, 1 September 1933, WUD—the earliest collection; *Pringle 1365*, 9 Aug 1972, HAM; *Laureto 1119*, 3 August 2001, WMU (Fig. 2).

Description

Perennial herb. Stems 4–7+ dm tall, erect, arising singly from a branching caudex. Proximal to mid-stem glabrous, becoming increasingly strigillose distally. Basal leaves tapering to a long, winged frimbriate petiole. Petiole bases marcescent (attached to old stems for more than one season). Blades ovate, 10–24 mm wide, 3-nerved (2 prominent lateral nerves arising proximally and running alongside midnerve for some distance before diverging), surfaces glabrous, margins ciliate, sparsely to regularly serrulate, each tooth appressed and ending in a gland, apices acute. Proximal cauline leaves tapering to winged petiole-like bases partially clasping stems, linear-oblanceolate, 150–180 mm long, 10–24 mm wide, glabrous, 3-nerved, margins ciliate, entire, apices acute. Mid-cauline to distal leaves sessile, blades linear-lanceolate, mid often obscurely 3-nerved, distal 1-nerved, 60–100 mm long, 5–10 mm wide, reduced distally. Heads (15–) 20–60 (–100+), not secund, in corymbiform arrays. Branches and peduncles moderately to densely strigillose, peduncles 6–12 mm long with 0–3 linear bracteoles. Involucres campanulate, 6–9 mm long. Phyllaries 18–24 in 3–4 series, unequal, linear to oblanceolate, 3-nerved, margins ciliate, apices obtuse to rounded. Ray florets 6–8, bright yellow, laminae 6.5–7.5 mm long and 1.2–2.0 mm wide. Disc florets 9–14, bright yellow, corollas 4.0–4.5 mm, lobes 1.0–1.4 mm. Achene obconic, 1.8–2.5 mm, glabrous, ribbed (ribs sometimes dark). Pappus of bristles of varying length, the longer ones 4.0–5.5 mm, not clavate.

Etymology

The specific epithet honors Dr. Edward G. Voss, a world-renowned botanist from Michigan who wrote the manual on Michigan's flora—*Michigan Flora Volumes I–III* (Voss 1972; Voss 1985; Voss 1996). Dr. Voss taught at the University of Michigan for decades, served on the editorial committee for the International Code of Botanical Nomenclature from 1969 to 1993, chaired the General Committee on Botanical Nomenclature from 1999 to 2005, founded *The Michigan Botanist*, and was its editor from 1962 to 1976.

Ploidy Determination

Observations of root tip meristem cells at metaphase of mitosis revealed that the chromosome number of *Solidago vossii* is $2n = 8x = 72$. Figure 5 presents a *S. vossii* root-tip cell at the metaphase stage of mitosis.

The term "ploidy" refers to the number of sets of chromosomes that an indi-

FIGURE 2. *Solidago vossii* J. S. Pringle and P. J. Laureto (drawn by P. J. Laureto). A. habit. B. Basal leaf. C. Head with only some florets drawn. D. Phyllary with chlorophyllous zone dark. E. Achene, mature, with disc floret and pappus still attached.

vidual possesses and it is notated by an "*x*". An individual with two sets of chromosomes is referred to as a diploid (2*x*), three sets would be a triploid (3*x*), and so on with tetraploid (4*x*), pentaploid (5*x*), etc. It is also important to identify if one is referring to the reduced number of chromosomes found in egg and sperm cells (denoted as "*n*") or the number of chromosomes in non-reduced tissue (denoted as "2*n*"). The base number of chromosomes in the genus *Solidago* is reported to be $x = 9$ (Semple et al. 1984; Semple and Cook 2006). Since *S. vossii* has eight times that amount it is an octoploid species, the only known octoploid species of goldenrod.

The nuclear DNA content of 23 *Solidago vossii* individuals was estimated by FCM. Figure 6 shows typical histograms for the octoploid *S. vossii* and a diploid

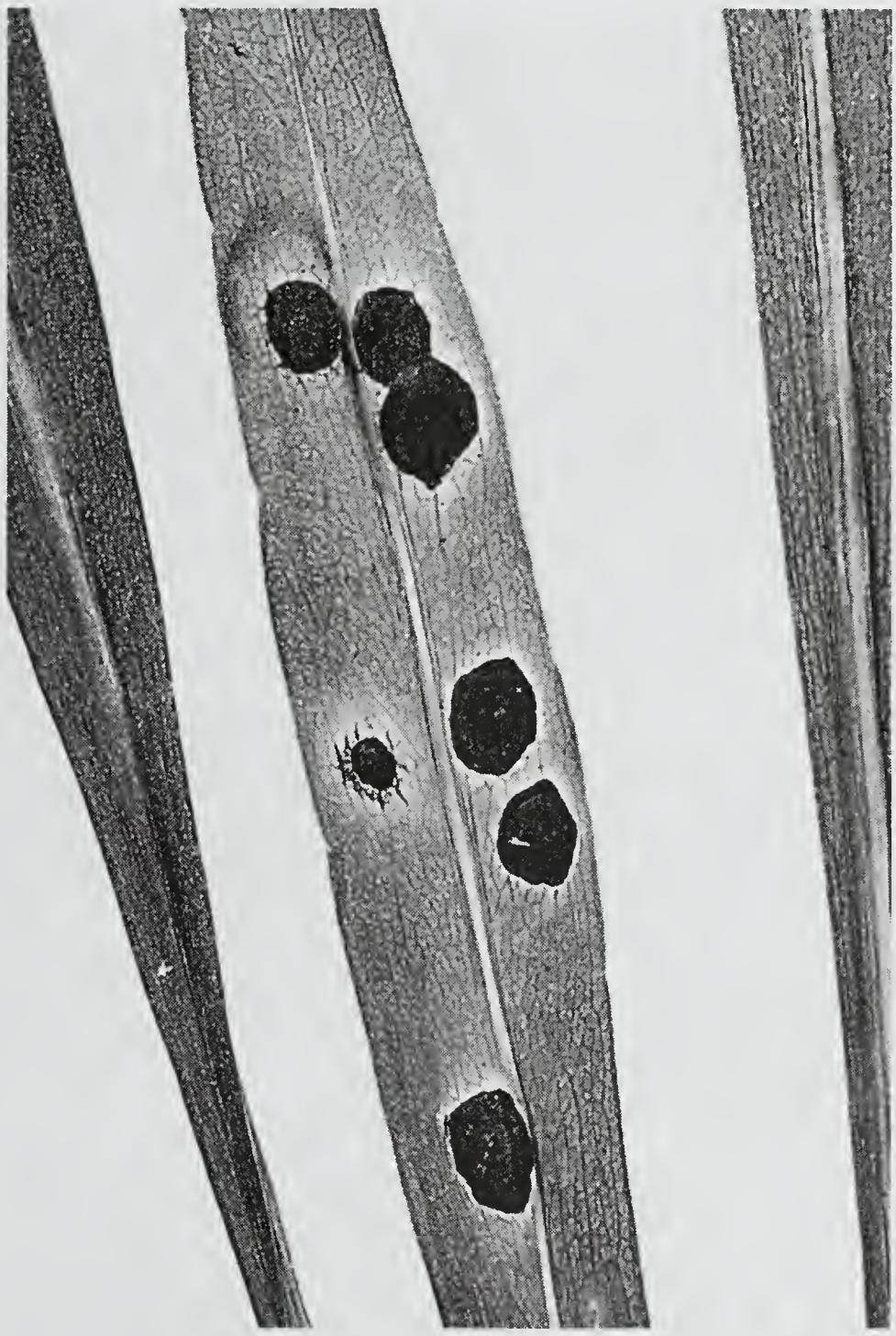

FIGURE 3. Photo of *Solidago vossii* leaf showing black fungal spots. Note the sparsely toothed margin. (Photo by J. S. Pringle)

Solidago, *S. hispida*, as analyzed by FCM. The mean DNA content of 24 diploid *Solidago hispida* samples was 2.086 pg per nucleus (Jess Peirson, unpublished data). The nuclear DNA content of all accessions of *S. vossii* ranged from 7.334 to 7.759 pg/2C nucleus (Table 2). The difference between the sample with the lowest (Arrowhead Rd. 07—7.334 pg per nucleus) and the highest value (Howes Lake 01—7.759 pg per nucleus) was 0.425 pg (= 1.058-fold) with a mean DNA content of 7.507 pg per nucleus. The mean nuclear DNA content of *S. vossii* is 3.599-fold greater than the diploid *S. hispida*, indicating that *S. vossii* is octoploid throughout its range.

Relationships

Solidago vossii belongs to *Solidago* sect. *Ptarmicoidei* because of its corymboid inflorescence, its rosette of large basal leaves with marcescent petiole

FIGURE 4. A. Habitat of *Solidago vossii* along the northeast shore of Howes Lake during peak flowering. B. Habitat at Portage Creek during late fall showing numerous seed heads. C. *Solidago vossii* growing in the gravel at the edge of Arrowhead Road. (Photos by P. J. Laureto)

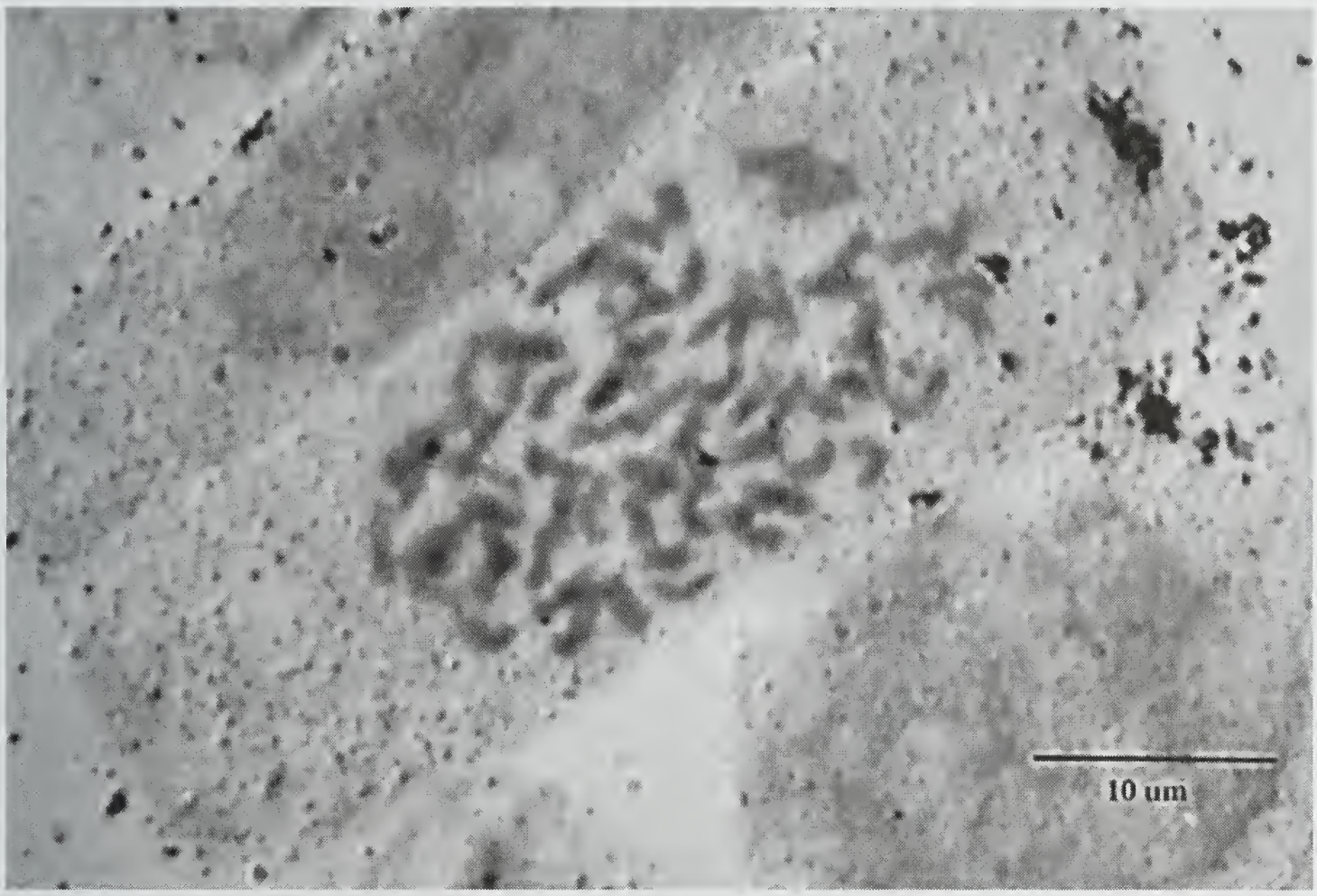

FIGURE 5. Micrograph of *Solidago vossii* root tip cell at metaphase showing $2n = 8x = 72$ chromosomes.

bases, and its oligoneurate phyllaries (Semple and Gandhi 2004). Morphologically, the closest species to *S. vossii* is *S. houghtonii*. Both species have a corymboid inflorescence of large, bright yellow heads, hairs in the inflorescence, a basal rosette of strap-shaped leaves arising from a branched caudex, and a similar 3-nerved pattern of leaf venation. However, *S. vossii* can be easily distinguished from *S. houghtonii*. *Solidago vossii* is generally a larger plant. Its ray florets are much wider than those of *S. houghtonii*, its distal stem and the branches and pedicles of its inflorescence have many more hairs than those of *S. houghtonii*, and most notably, its basal leaves have gland-tipped teeth, which are lacking in *S. houghtonii*. *Solidago vossii* and *S. houghtonii* are compared morphologically in Table 1.

Laureto's (2010; Laureto and Barkman, in press) phylogenetic study on the hybrid origin of *Solidago houghtonii* found that the octoploid population, recognized here as the new species *S. vossii*, shares the same parental taxa as true *S. houghtonii*. This suggests that the octoploid *S. vossii* may have been derived from the hexaploid *S. houghtonii*; although diploid × polyploid crosses are highly unlikely (J. Semple pers. comm.). Alternatively, *S. vossii* may have arisen through independent hybridization events involving the same parental taxa as *S. houghtonii*.

While *Solidago vossii* is morphologically similar to and shares the same parental taxa as *S. houghtonii* its octoploid genome size would prevent it from

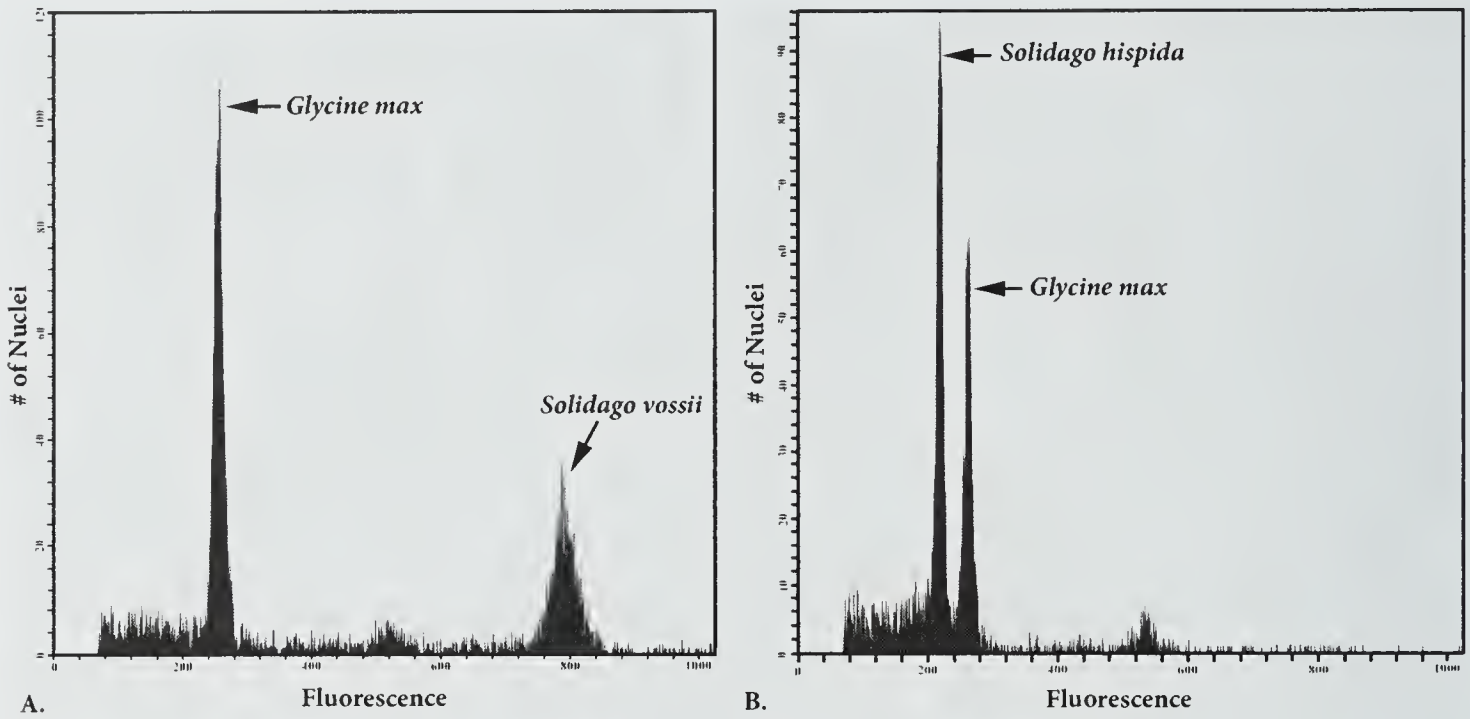

FIGURE 6. Integrated fluorescence histograms of nuclei isolated during FCM analysis. A. The octoploid *Solidago vossii* (sample 01 from Howes Lake) and B. a diploid *Solidago* species (*S. hispida*). Each were isolated, stained and analyzed simultaneously with the internal reference standard *Glycine max* 'Polanka' (2C = 2.50 pg DNA). The ratio of the *Glycine max* peak means that *S. vossii* was equal to 3.104 and hence the 2C DNA amount of *S. vossii* was estimated as 7.759 pg indicating the plant is octoploid. For comparison, the ratio of the *Glycine max* peak for the diploid *S. hispida* was 0.834 indicating a 2C DNA amount of 2.086 pg. Note that the y-axis scale varies between samples. Fluorescence was measured with a 585/42 (FL2) photodetector. Note that the y-axis scale varies between samples (A. 0–120, B. 0–90).

interbreeding with the hexaploid *S. houghtonii*. This supports its recognition as a new species.

An unusual characteristic of *S. vossii* plants, observed in the field by Pringle in 1972 and by Laureto in 2002 and in 2010, is that the plants seem regularly to be infected with a leaf fungus (Fig. 3). The fungus forms blackish, circular spots 4–10 mm in diameter. Neither Laureto nor Pringle have observed leaf fungi on any plants of *S. houghtonii*. These leaf fungi may serve as an unusual diagnostic character for *S. vossii*.

Distribution and Habitat

This new species is endemic and apparently rare in the state of Michigan, U.S.A. Its primary distribution is an area of approximately 2.25 square miles in southern Crawford and Kalkaska counties (Fig. 1). All occurrences are located on State land within the Hanson State Game Refuge and the Camp Grayling Military Reservation, a National Guard training facility that is managed by the Michigan Department of Military Affairs. In addition to the primary distribution, there is one small population located along the entrance road to Camp Grayling on the east side of Lake Margrethe.

As noted above, the first collection of this new species was made in 1933 at Howes Lake (the type locality). According to our field observations and reports prepared for the Camp Grayling Military Reservation (Higman et al. 1994), the plants occur in abundance from the northeast shore of Howes Lake (Fig. 1; Fig. 4a) southwest to Portage Creek (Fig. 1; Fig. 4b). They can even be found grow-

TABLE 2. Assessment of the ploidy level of 23 *Solidago vossii* individuals using the nuclear DNA content (pg/2C) determined through flow cytometry. All *S. vossii* samples have a coefficient of variation (C.V.) value less than 7 indicating a relatively small and acceptable variation between the florescence peaks of the sample as compared to the internal standard. The average *S. hispida* nuclear DNA content is provided for comparison (Jess Peirson, unpublished data).

Species	Population/Sample	DNA pg / 2C	S. vossii C.V.	Interpretation of ploidy level
Solidago vossii	Arrowhead Road 01	7.601	2.1	8x
	Arrowhead Road 02	7.452	2.6	8x
	Arrowhead Road 03	7.497	2.7	8x
	Arrowhead Road 04	7.566	3.4	8x
	Arrowhead Road 05	7.512	2.1	8x
	Arrowhead Road 06	7.462	3.1	8x
	Arrowhead Road 07	7.334	3.1	8x
	Arrowhead Road 08	7.474	2.8	8x
	Arrowhead Road 09	7.665	3.1	8x
	Arrowhead Road 10	7.401	2.7	8x
	Howes Lake 01	7.759	2.5	8x
	Portage Creek 01	7.421	2.2	8x
	Portage Creek 02	7.548	2.6	8x
	Portage Creek 03	7.627	2.3	8x
	Portage Creek 04	7.383	2.2	8x
	Portage Creek 05	7.466	2	8x
	Portage Creek 06	7.421	2.6	8x
	Portage Creek 07	7.581	2.2	8x
	Portage Creek 08	7.426	2.7	8x
	Portage Creek 09	7.343	3	8x
	Portage Creek 10	7.532	3.1	8x
	Portage Creek 11	7.431	2.9	8x
	Portage Creek 12	7.657	3	8x
Solidago hispida		AVG = 2.086		2x

ing in the gravel along the edges of roads that wind through the area (Fig. 4c). The primary site is about 5.5 km (3 miles) long and 1.2 km (0.75 miles) wide. Higman et al. 1994 described this site as a sandy glacial outwash plain with low dune ridges. The dune ridges represent the former shorelines of postglacial Lake Margrethe. The vegetation type of this new species' habitat is fen to northern wet prairie within a jack pine barrens/wet prairie complex (Higman et al. 1994). Here the plants occur in the alkaline soils of intermittent wetlands and old interdunal depressions along with several other species that are characteristic of Great Lakes interdunal wetlands. In addition, there are many species characteristic of mesic sand prairies. Plant associates include such species as *Pinus banksiana* (jack pine), *Andropogon gerardii* (big bluestem), *Hypericum kalmianum* (Kalm's St. Johnswort), *Potentilla fruiticosa* (shrubby cinquefoil), *Prunus pumila* (sand cherry), *Lobelia spicata* (lobelia), *Castilleja coccinea* (Indian paintbrush), *Houstonia longifolia* (long-leaved bluets), *Eleocharis elliptica* (spikerush), and *Carex conoidea* and *C. flava* (sedges). Several other rare plant species are located within this unique wet prairie complex including the special concern *Trichophorum clintonii* (Clinton's bulrush) and *Sporobolus heterolepis*

(prairie dropseed), and the state threatened *Juncus vaseyi* (Vasey's rush), and *Viola novae-angliae* (New England violet) (USFWS 1997).

Conservation Status

Like many rare plants, *Solidago vossii* is vulnerable to extirpation because of its small population size; all but a few individuals occur within a 2.25 square mile area. The population is further at risk due to disturbance from frequent illegal off-road-vehicle (ORV) use (personal observation; USFWS 1997). Currently the Department of Military Affair's environmental staff is managing the Federal and State listed species within the Camp Grayling Reserve (Larry Jacobs, Michigan Department of Military Affair's, pers. comm. 2010). Barricades have been erected in many areas to prevent ORV traffic and other areas have signage warning of protected species.

Recognizing that the plants from Crawford and Kalkaska counties are not *Solidago houghtonii* affects the population in a substantial way; it loses its federal protected status as part of a threatened species. Identifying these plants as a new species means that they are even rarer than *S. houghtonii*, and we recommend them for consideration for future federal listing and encourage the State of Michigan to award them immediate state protection.

ACKNOWLEDGMENTS

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TREE COMPOSITION AND DEMOGRAPHY OF A SECOND GROWTH HARDWOOD FOREST IN BERRIEN COUNTY, MICHIGAN

Robert Tatina

Dakota Wesleyan University
Biology Department
Mitchell, SD 57301
rotatina@dwu.edu

ABSTRACT

The tree species composition of a small, second growth forest in Berrien County, Michigan, about one-half mile east of Lake Michigan, was determined from tree numbers and diameters gathered using the T-square method. The forest is dominated by northern red oak (*Quercus rubra*), eastern white pine (*Pinus strobus*) and red maple (*Acer rubrum*). When compared to upland sites, lowland sites had greater species diversity (14 compared to 11) and a greater basal area (57.84 compared to 39.16 $m^2 \cdot ha^{-1}$), but had a lower density (317.89 compared to 357.05 trees $\cdot ha^{-1}$) of trees. Size class structure of the tree species generally showed that they were replacing themselves and will continue for some time into the future.

KEY WORDS: Berrien County, Michigan, Southern Mesic Hardwood Forest, Species Composition, Tree Size Classes

INTRODUCTION

According to original land survey records, the vegetation of Berrien County, Michigan, prior to settlement by non-native people was hardwood forest with dominance shared by American beech (*Fagus grandifolia*) and sugar maple (*Acer saccharum*) (Brewer et al. 1984). Since then much of the county has been logged (Coolidge 1906) and some of it burned (Ellis 1880), leaving a mosaic of agricultural land, forests and commercial and residential developments. Over time, the once grand forests of Michigan have become reduced in area, and today represent about half of their former extent (Dickmann and Leefers 2003). Presently, most of the forested stands are second growth.

Two forests in Berrien County have been the subject of continuing research. These are the beech-maple forest at Warren Woods State Park studied by Billington (1924), Cain (1935), Brewer and Merritt (1978), Woods (1979), Brewer (1980), and Donnelly and Murphy (1987) and the several forest types at Warren Dunes State Park described by Wells and Thompson (1982), Smith and Woodland (2006) and Smith and Woodland (2007). These have provided much insight into the composition and dynamics of old growth, hardwood forests as well as a benchmark against which to compare other forests. However, most of the forests in southwestern Michigan, as well as the rest of the state, are second growth and young with little attention paid to their composition and dynamics.

This study was conducted in a small, second growth forest in southwestern Michigan about five miles north of Warren Woods State Park and within a half mile south of the woods at Warren Dunes State Park. Prior to sampling the trees, I compiled a list of 184 vascular plant species and from it estimated the Floristic Quality Index to be greater than 50. My objectives were 1) to describe the composition of the forest in terms of its tree species and 2) to examine the size class (age) structure of the tree species to estimate what the composition of this forest might be in the future.

STUDY AREA

The study area (Figure 1) is a forested stand of approximately 8.1 ha, ~ 1 km WNW of Sawyer, Michigan. Its legal description is T7S, R20E, Sec. 2, NW 1/4, SW 1/4. On the south it is bounded by Lake Lane and on the west by Tower Hill Road. From the southwest corner, the area extends ~250 m N and ~400 m E. It is the southern end of the Tower Hill Camp and Retreat Center (THC), a 22-hectare tract which was donated to the Illinois Conference of the United Church of Christ by Edward K. Warren in 1923 (Gregg Briggs, THC Director, personal communication). The site is approximately 0.75 km southeast of Lake Michigan.

Although I was unable to find specific information about the property prior to it being converted into a camp, circumstantial evidence suggests that the area was logged. In 1854 a saw mill was operating in Sawyer, and in 1861 there was another saw mill operating in the vicinity with a horse drawn railroad running through the area of the camp down to a pier on Lake Michigan at the Chikaming—Lake Township boundary (Coolidge 1906). These historical notes would suggest that the area had been logged as early as the mid 1800s.

The age of the stand, estimated from tree cores of some of the larger red oaks, is about 70–80 years old. Immediately to the north of the stand is a white pine planting with trees standing in obvious rows. These trees were aged at 70–80 years also. The absence of sawed tree stumps indicates that the area had not been logged recently. In addition, there is no evidence of recent fire.

The topography is rolling with small hills that peak at approximately 200 m above sea level and low areas at 190 m. The soils are sandy and have been mapped as Oakville fine sands on ridge tops, knolls and slopes and Pipestone sand and Grandby loamy fine sand on nearly level areas (Larson 1980). The Oakville fine sands have rapid infiltration rates, and the Pipestone sand and Grandby loamy fine sand are poorly drained because of a high water table (Larson 1980). Generally, the forest fits a southern mesic hardwood forest as described by Kost et al. (2007).

METHODS

During the summer, 2009, starting at the SW corner of the study area, I laid out a grid of sampling points 20 m in from the property lines and 20 m apart. From the resulting 250 intersecting lines, ~150 intersections were chosen at random to become sampling point centers. (Excluded from sam-

pling was a portion of the woods where white pines had been planted in obvious rows and marked as "Pines" in Figure 1.) To determine which two trees at each sampling point were to be measured, I followed the T-square plotless sampling method because it overcomes sampling biases when trees are not randomly distributed (Greenwood 1996). (I chose this method as an alternative to determining the actual distributional pattern of the trees.) Selecting the tree nearest a sampling point, I measured the distance between its center and the sampling point and then measured the circumference of the tree at breast height (1.4 m). Following the sampling procedures of Curtis (1959), I designated tree size class individuals as those that had a diameter at breast height (dbh) ≥ 10 cm. The second tree to be measured was the nearest neighbor to the first tree found beyond a line drawn through the first tree perpendicular to a line extending from the sampling point to the first tree. I then measured the distance between the first tree and the second tree, and measured the circumference of the second tree at breast height.

Saplings (tree species whose dbh < 10 cm and whose height ≥ 30 cm) were counted by dbh size class (< 2; ≥ 2 < 4; ≥ 4 < 6; ≥ 6 < 8; ≥ 8 < 10 cm) in 0.01 ha circular plots (radius = 5.64 m) whose radii extended from each sampling point. Seedlings (< 2 cm dbh and < 30 cm tall) of tree species were counted in 0.002 ha circular plots (radius = 2.52 m) centered on the sampling point. I also noted whether the point and the sampling area were located in a lowland or an upland. Generally, the lowland points were located at the southern and eastern edges of the forest and had water standing in depressions in the spring, 2009. The uplands were on shallow slopes and hills and showed no evidence of having been inundated.

Density of tree size class species was determined from distance measurements using the following: density = $n^2/2.2828\Sigma x\Sigma y$, in which n is the number of sampling points, x is the distance to the nearest tree from a sampling point and y is the distance from the first tree to its nearest neighbor (Greenwood 1996). For sapling and seedling species, density was calculated by dividing the number of individuals counted by the total area sampled. Tree circumferences were converted into basal areas and then summed by species; points of occurrence were converted into frequency by dividing the number of points of occurrence by the number of points sampled. Density, basal area and frequency for each tree size class species were relativized and then summed to produce importance values (IV).

With an increment borer I extracted cores at breast height from several larger trees. After drying the cores I counted the annual rings to determine the approximate age of each tree. Scientific nomenclature follows that of Gleason and Cronquist (1991), and common names of trees that of Barnes and Wagner (2004).

RESULTS

Increment cores taken from seven species of larger trees produced ages that fell into two groups (Table 1). Except for *Fagus grandifolia*, which averaged about 125 years old, all of the other species were 70 to 80 years old.

Table 2 shows the tree species composition for the entire forest. The stand had a total density of nearly 342 trees · ha^{-1} and a total basal area of 122.50 m^2 · ha^{-1}. The average distance between trees was 3.95 m ± 2.39 (sd). Based on IVs, dominant tree species were *Quercus rubra* (northern red oak), *Pinus strobus* (eastern white pine) and *Acer rubrum* (northern red maple). *Acer rubrum* existed at the highest density (69.05 trees · ha^{-1}). At an average dbh of 0.630 m, *Liriodendron tulipifera* (tulip tree) comprised the largest trees, one of these having a dbh of 1.251 m. Other common tree species included *Prunus serotina* (black cherry), *Fagus grandifolia*, *Nyssa sylvatica* (black gum) and *Acer saccharum* (sugar maple).

Tables 3 and 4 show the composition of the forest when sampling points are divided into lowlands and uplands. The 91 trees sampled at 42 points in the

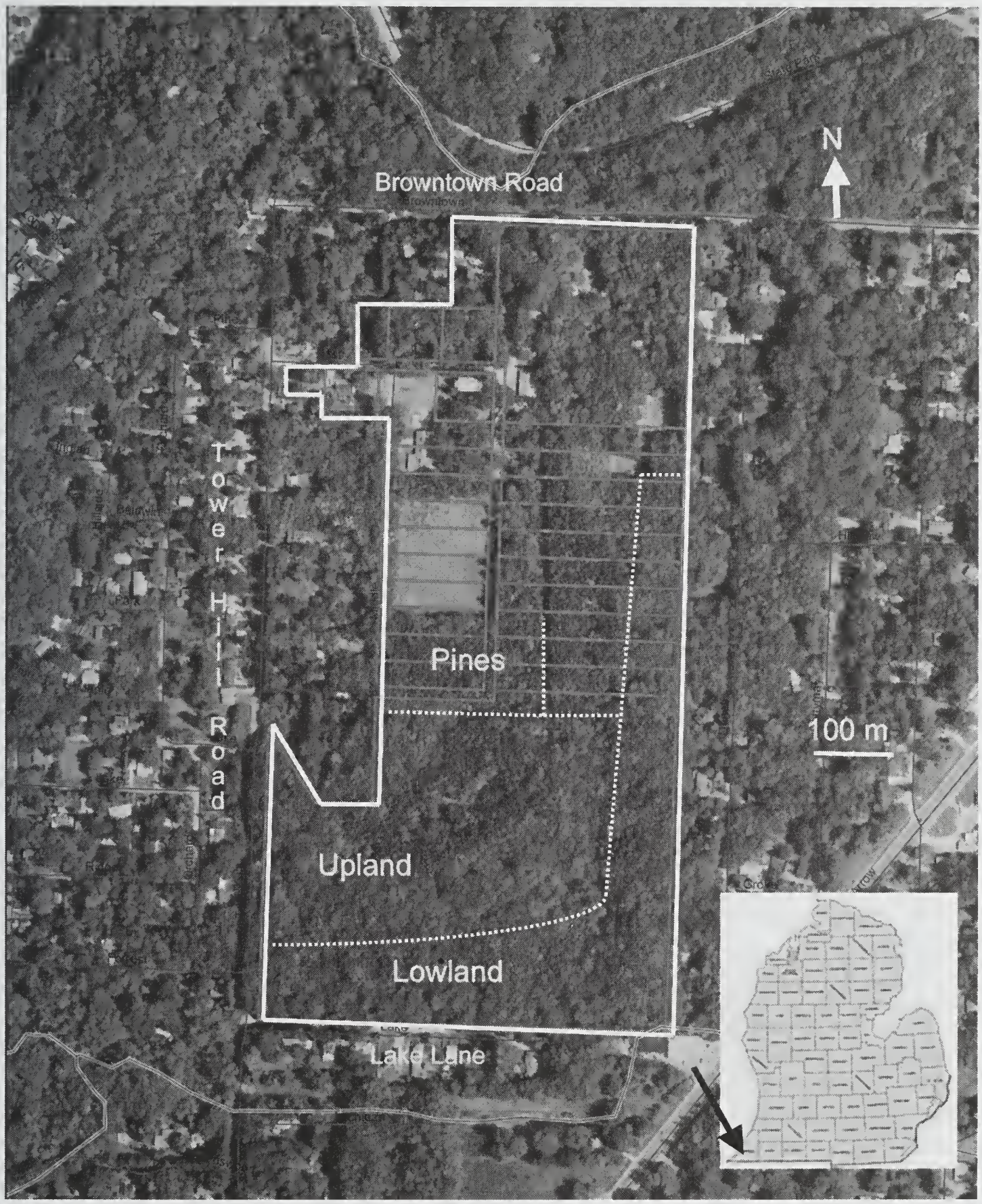


FIGURE 1. Aerial view of Tower Hill Camp and Retreat Center, Berrien County, Sawyer, Michigan. The areas sampled in this study are indicated as Upland and Lowland. Excluded was the area labeled "Pines".

lower, wetter portions of the study area were divided among 14 species which existed at a density of 317.89 trees · ha^{-1} (Table 3). The average distance between trees was 4.24 m ± 2.54 (sd). On the lowland sites *Acer rubrum* and *Liriodendron tulipifera* were the most important trees species, with *Acer rubrum* having the highest density (96.74 trees · ha^{-1}) and greatest basal area per hectare

TABLE 1. Ages and diameters (dbh) of tree species from Tower Hill Camp and Retreat Center, Sawyer, Michigan. Where more than one tree was cored, values for ages and diameters are means ± sd.

SPECIES	AGE (years)	dbh (meters)	N
Acer rubrum	73.00 ± 20.25	0.65 ± 0.15	4
Pinus strobus	72.83 ± 4.67	0.53 ± 0.22	6
Fagus grandifolia	125.50 ± 2.12	0.73 ± 0.13	2
Prunus serotina	81	0.79	1
Liriodendron tulipifera	85	0.55	1
Sassafras albidum	88	0.46	1
Picea abies	82.00 ± 2.00	0.51 ± 0.19	3

(21.87 $m^2 \cdot ha^{-1}$). Other frequently encountered species were *Prunus serotina*, *Quercus rubra* and *Nyssa sylvatica*. Species encountered at lowland sites, but not upland sites were *Betula alleghaniensis* (yellow birch), *Picea abies* (Norway spruce), *Carpinus caroliniana* (blue-beech), *Carya ovata* (shagbark hickory) and *Fraxinus pennsylvanica* (red ash).

The 81 points sampled at upland locations contained 11 species at a total density of 357.05 trees $\cdot ha^{-1}$ (Table 4). The average distance between trees was 3.82 m ± 2.28 (sd). *Pinus strobus* and *Quercus rubra* shared dominance here and together accounted for 63% of the trees. Two species, *Ostrya virginiana* (hophornbeam) and *Quercus alba* (white oak) were found at upland points only, albeit infrequently.

When compared to upland sites (Table 4), lowland sites (Table 3) were found to have a greater species diversity (14 compared to 11) and a greater basal area (57.84 compared to 39.16 $m^2 \cdot ha^{-1}$) but a lower density of trees (317.89 compared to 357.05 trees $\cdot ha^{-1}$). The average distance between trees at lowland sites was not significantly different from that of the uplands ($t = 0.91$, df = 85, $P = 0.37$). Although *Acer rubrum* and *Liriodendron tulipifera* were present at both lowland and upland sites, these two species had higher IVs at lowland sites. The opposite statement can be made for *Pinus strobus* and *Quercus rubra* whose IVs were significantly higher at upland sites.

Figure 2 shows the density of tree species by one seedling, five sapling and two tree size classes. For *Acer rubrum*, *Fagus grandifolia* (Figure 2A, B), *Acer saccharum* (Figure 2C), *Prunus serotina* (Figure 2D) and *Nyssa sylvatica* (Figure 2E) there was a general decrease in density from seedling through tree size classes. In most of these species, the 25-cm dbh midpoint size class showed an increase over the larger sapling size classes. For example, in *Acer rubrum* (Figure 2A) the 25 cm size class exceeded the 7 cm and 9 cm size classes. This anomaly may be an artifact of having divided all of the stems greater than 10 cm dbh into only two size classes and might disappear if they had been divided among more size classes.

While not abundant in any size class, *Fagus grandifolia* (Figure 2B), *Acer saccharum* (Figure 2C) and *Nyssa sylvatica* (Figure 2E) had low densities of trees larger than 25 cm. *Quercus rubra* stem densities (Figure 2F) generally

TABLE 2. Tree species composition for all grid points in woods at Tower Hill Camp and Retreat Center, Sawyer. Michigan. ACRU = *Acer rubrum*, ACSA = *Acer saccharum*, BEAL = *Betula alleghaniensis*, CACA = *Carpinus caoliniana*, CAOV = *Carya ovata*, FAGR = *Fagus grandifolia*, FRPE = *Fraxinus pennsylvanica*, LITU = *Liriodendron tulipifera*, NYSY = *Nyssa sylvatica*, OSVI = *Ostrya virginiana*, PIAB = *Picea abies*, PIST = *Pinus strobus*, PRSE = *Prunus serotina*, QUAL = *Quercus alb*a, QURU = *Quercus rubra*, SAAL = *Sassafras albidum*, # Trees = number of trees counted and measured, BA = basal area, Rel Dom = Relative Dominance, Rel Dens = Relative Density, # Pts = Number of grid points of occurrence, Rel Freq = Relative Frequency, IV = Importance Value (Sum of Rel Dom, Rel Dens and Rel Freq).

Spp.	# Trees	Mean (sd) dbh	Max dbh	BA (m^2/ ha)	Rel Dom	Trees/ ha	Rel Dens	# Pts	Freq	Rel Freq	IV
QURU	57	0.361 (0.219)	1.152	24.920	8	69.05	20.22	40	0.284	18.78	60.19
PIST	62	0.302 (0.163)	1.069	22.680	12.85	75.10	21.99	40	0.284	18.78	53.62
ACRU	43	0.415 (0.235)	1.075	21.613	20.37	52.08	15.25	35	0.248	16.43	52.05
LITU	23	0.630 (0.232)	1.251	17.552	21.61	27.86	8.16	20	0.142	9.39	39.16
PRSE	26	0.346 (0.141)	0.579	10.899	7.56	31.5	9.22	23	0.163	10.80	27.58
FAGR	19	0.345 (0.219)	0.793	7.942	6.54	23.02	6.74	14	0.099	6.57	19.85
NYSY	16	0.249 (0.120)	0.522	4.826	2.53	19.38	5.67	12	0.085	5.63	13.83
ACSA	11	0.236 (0.173)	0.057	3.143	1.91	13.32	3.90	9	0.064	4.22	10.03
SAAL	9	0.247 (0.074)	0.360	2.690	1.24	10.90	3.19	8	0.057	3.75	8.18
PIAB	6	0.408 (0.098)	0.541	2.966	2.19	7.27	2.13	4	0.028	1.88	6.20
BEAL	3	0.281 (.0143)	0.446	1.020	0.58	3.63	1.06	2	0.014	0.94	2.58
QUAL	2	0.404 (0.040)	0.433	0.978	0.69	2.42	0.71	1	0.007	0.47	1.87
OSVI	2	0.170 (0.035)	0.194	0.411	0.12	2.42	0.71	2	0.014	0.94	1.77
FRPE	1	0.458	0.458	0.554	0.56	1.21	0.35	1	0.007	0.47	1.38
CAOV	1	0.134	0.134	0.162	0.04	1.21	0.35	1	0.007	0.47	0.86
CACA	1	0.120	0.120	0.145	0.03	1.21	0.35	1	0.007	0.47	0.85
Totals	282			122.501	86.82	341.58	100	213	1.511	99.99	300.00

TABLE 3. Tree species composition for lowland grid points in woods at Tower Hill Camp and Retreat Center, Sawyer. Michigan. ACRU = *Acer rubrum*, ACSA = *Acer saccharum*, BEAL = *Betula alleghaniensis*, CACA = *Carpinus caroliniana*, CAOV = *Carya ovata*, FAGR = *Fagus grandifolia*, FRPE = *Fraxinus pennsylvanica*, LITU = *Liriodendron tulipifera*, NYSY = *Nyssa sylvatica*, PIAB = *Picea abies*, PIST = *Pinus strobus*, PRSE = *Prunus serotina*, QURU = *Quercus rubra*, SAAL = *Sassafras albidum*, # Pts = Number of grid points of occurrence , # Trees = Number of trees, Tr/ha = Number of trees per hectare, BA = basal area, Rel Dom = Relative Dominance, Rel Dens = Relative Density, Rel Freq = Relative Frequency, IV = Importance Value (Sum of Rel Dom, Rel Dens and Rel Freq).

Spp	# Pts	# Trees	Tr/ha	BA (m^2)	BA (m^2/ha)	Rel Freq	Rel Dens	Rel Dom	IV
ACRU	19	28	96.74	6.33	21.87	27.54	30.43	13.35	71.32
LITU	12	13	44.92	5.10	17.62	17.39	14.13	23.19	54.71
PRSE	9	11	38.02	1.01	3.49	13.04	11.96	5.42	30.42
QURU	6	9	31.09	1.79	6.18	8.70	9.78	11.78	30.26
NYSY	6	9	31.09	0.43	1.49	8.70	9.78	2.80	21.28
FAGR	5	5	17.26	0.64	2.21	7.25	5.43	7.53	20.21
PIAB	2	3	10.36	0.57	1.97	2.90	3.26	11.18	17.34
SAAL	3	5	17.26	0.32	1.11	4.35	5.43	3.78	13.56
FRPE	1	1	3.47	0.16	0.55	1.45	1.09	9.75	12.29
BEAL	2	3	10.36	0.22	0.76	2.90	3.26	4.30	10.46
PIST	1	2	6.90	0.13	0.45	1.45	2.17	3.94	7.56
ACSA	1	1	3.47	0.02	0.07	1.45	1.09	1.47	4.01
CAOV	1	1	3.47	0.01	0.035	1.45	1.09	0.83	3.37
CACA	1	1	3.47	0.01	0.035	1.45	1.09	0.67	3.21
Totals	68	91	317.89	16.73	57.84	100.02	99.99	99.99	300.00

decreased from seedling through the 5 cm size class, followed by an increase in the 7 cm size class and an absence of individuals in the 9 cm size class. A similar trend was seen in *Fraxinus pennsylvanica* (Figure 2G), and *Liriodendron tulipifera* (Figure 2H). *Pinus strobus* densities (Figure 2I) never exceeded 100 stems · ha^{-1} in any size class, and had very low numbers of larger trees. *Picea abies* (Figure 2J) included seedlings, small saplings and larger trees but no larger saplings or smaller trees. *Quercus muehlenbergii* (chinkapin oak) (Figure 2K) was present only as seedlings and smaller saplings. Finally, *Sassafras albidum* (sassafras) (Figure 2L), an understory tree that occasionally reaches the canopy, generally showed a decrease in stems numbers from seedlings to smaller trees.

DISCUSSION

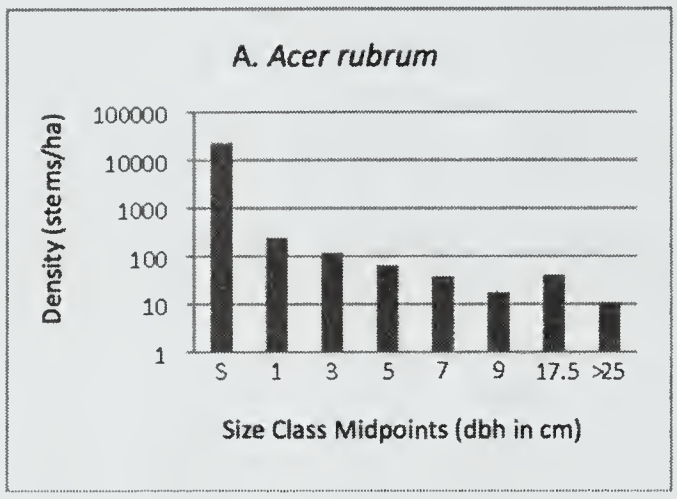
According to Herman et al. (2001), communities with FQI values above 50 are very rare and ". . . represent a significant component of Michigan native bio-

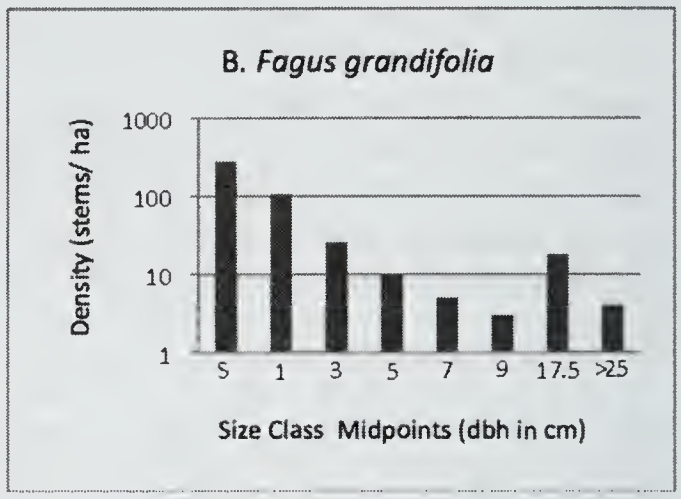
TABLE 4. Tree species composition for upland sampling points in woods at Tower Hill Camp and Retreat Center, Sawyer. Michigan. ACRU = *Acer rubrum*, ACSA = *Acer saccharum*, FAGR = *Fagus grandifolia*, LITU = *Liriodendron tulipifera*, NYSY = *Nyssa sylvatica*, OSVI = *Ostrya virginiana*, PIST = *Pinus strobus*, PRSE = *Prunus serotina*, QUAL = *Quercus alba*, QURU = *Quercus rubra*, SAAL = *Sassafras albidum*, # Pts = Number of grid points of occurrence, # Trees = Number of trees, Tr/ha = Number of trees/ha, BA = basal area, Rel Dom = Relative Dominance, Rel Dens = Relative Density, Rel Freq = Relative Frequency, IV = Importance Value (Sum of Rel Dom, Rel Dens and Rel Freq).

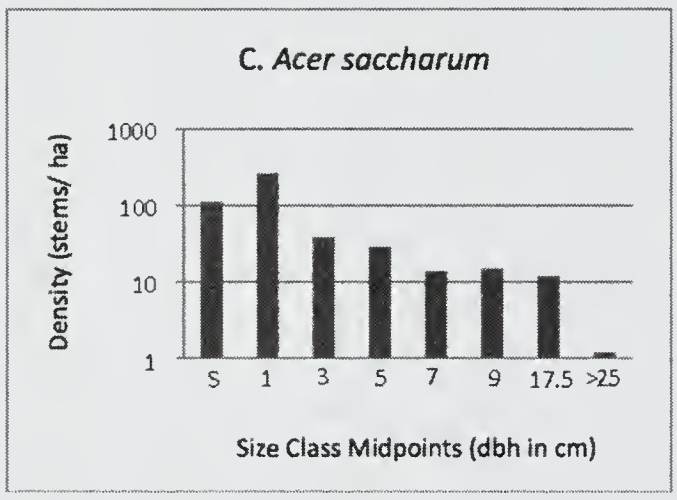
Spp	# Pts	# Trees	Tr/ha	BA (m^2)	BA (m^2/ha)	Rel Freq	Rel Dens	Rel Dom	IV
PIST	33	54	122.80	5.30	12.05	30.56	34.39	30.79	95.74
QURU	29	45	102.34	5.21	11.85	26.85	28.66	30.23	85.74
FAGR	8	13	29.57	1.75	3.98	7.41	8.28	10.15	25.84
LITU	6	7	15.93	1.90	4.32	5.56	4.46	11.06	21.08
PRSE	8	11	25.03	1.26	2.88	7.41	7.01	7.34	21.76
ACRU	9	9	20.46	0.81	1.84	8.33	5.73	4.71	18.77
ACSA	7	9	20.46	0.66	1.50	6.48	5.73	3.84	16.05
SAAL	3	3	6.82	0.08	0.18	2.78	1.91	0.44	5.13
NYSY	2	3	6.82	0.09	0.20	1.85	1.91	0.54	4.30
OSVI	2	2	4.53	0.05	0.11	1.85	1.27	0.27	3.39
QUAL	1	1	2.29	0.11	0.25	0.93	0.64	0.64	2.21
Totals	108	157	357.05	17.22	39.16	100.01	99.99	100.01	300.01

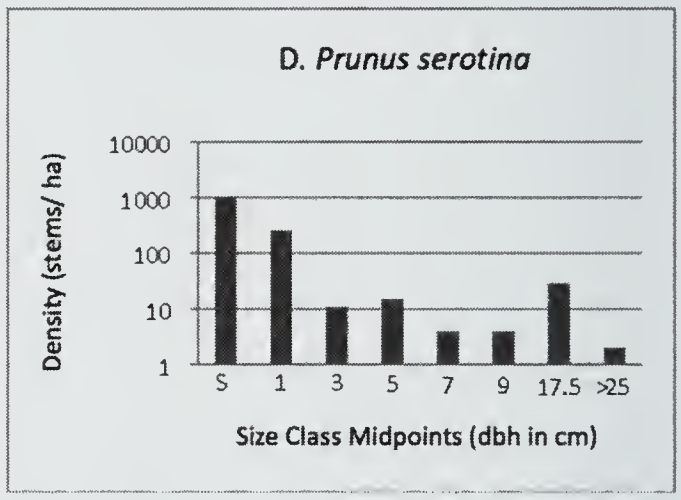
diversity and natural landscapes." With an FQI > 50, the woods at THC has a sizeable number of plant species that were present in similar habitats prior to settlement by non-native people and is worthy of preservation. Given that most of the trees aged from increment cores were about 70 to 80 years old makes this a young forest compared to that at nearby Warren Woods State Park where some trees exceed 300 years old (Poulson and Platt 1996). Thus the forest at THC is a second growth forest, one that probably had been harvested twice, once in the mid 1860s at the time of the first major logging in southwestern Michigan (Ellis 1880; Coolidge 1906) and then again around 1920.

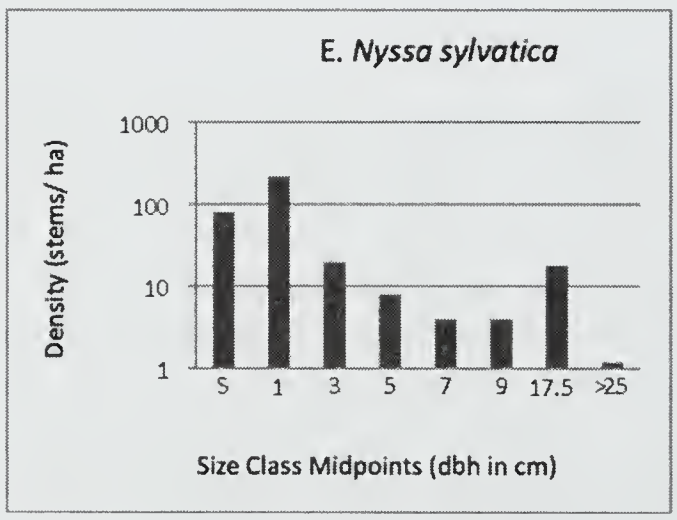
These woods, located in the southwest corner of Michigan, are within the southern mesic hardwood forest type (Kost et al. 2007). As such they should have *Fagus grandifolia* and *Acer saccharum* as codominant tree species. Some nearby forests which have been studied show this pattern of dominance (Cain 1935; Gysel 1951; Woods 1979; Poulson and Platt 1996). In the THC forest, neither *Fagus grandifolia* nor *Acer saccharum* is a dominant species. Instead this role has been taken over by *Quercus rubra*, *Pinus strobus* and *Acer rubrum*. This compares somewhat favorably to some of the forests at nearby Warren Dunes State Park. All eight stands sampled there had *Quercus rubra* as a dominant, however only two stands had any *Acer rubrum* (Smith and Woodland 2007), probably because they were in locations more arid than those at THC.











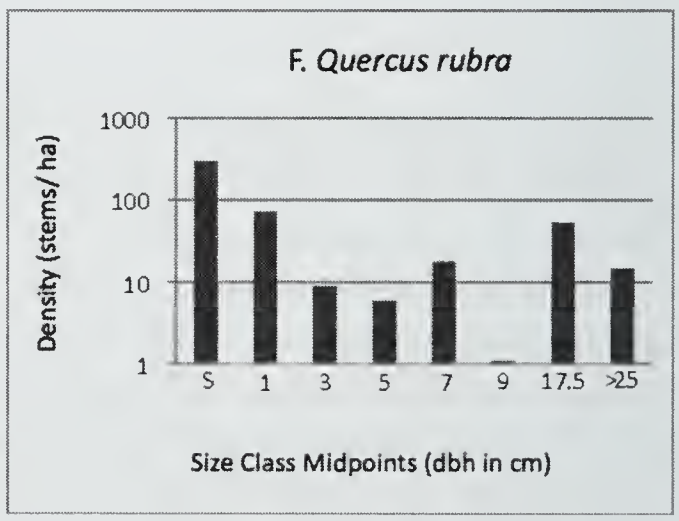
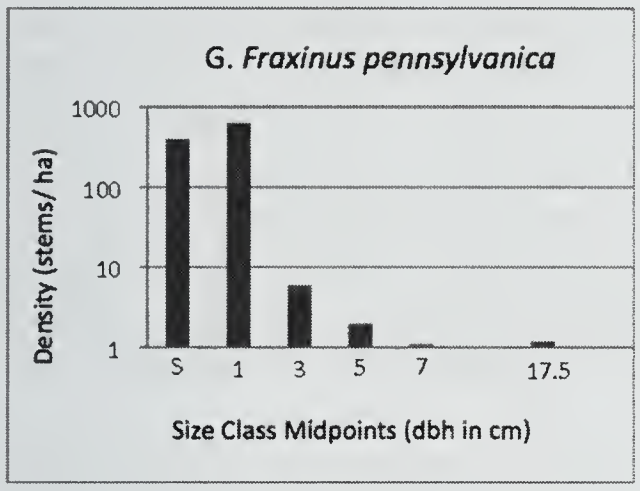
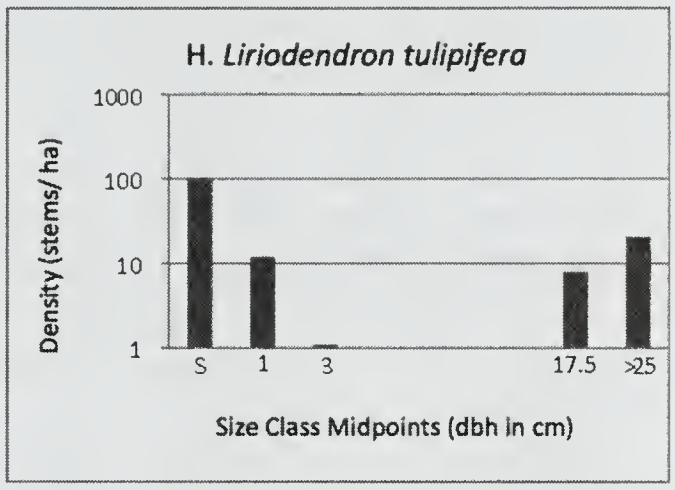
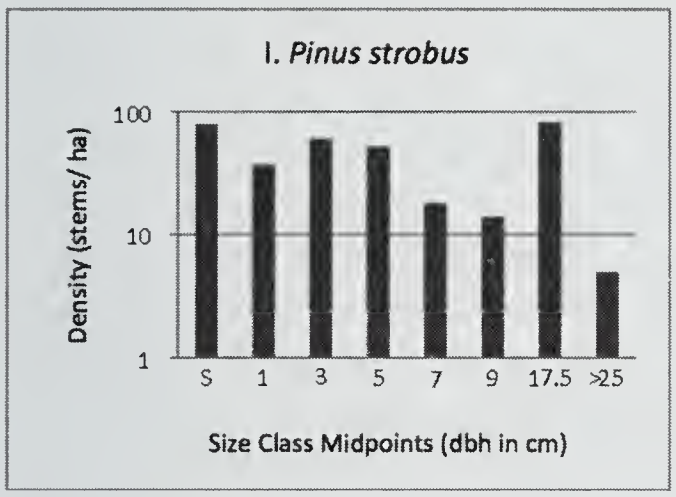


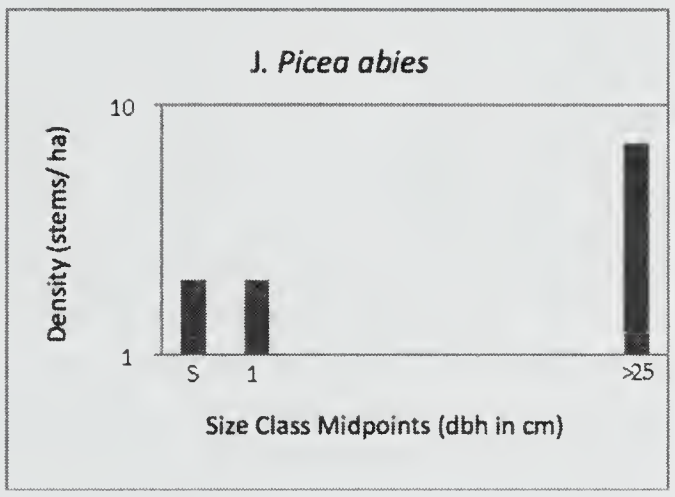
FIGURE 2. Stem density of tree species at Tower Hill Camp and Retreat Center, Berrien County, Sawyer, Michigan. S = Seedlings (< 30 cm tall), 1 = Saplings > 30 cm tall and < 2 cm dbh, 3 = Saplings 2.00 to 3.99 cm dbh, 5 = Saplings 4.00 to 5.99 cm dbh, 7 = Saplings 6.00 to 7.99 cm dbh, 9 = Saplings 8.00 to 9.99 cm dbh, 17.5 = Trees 10.00 to 24.99 cm dbh and > 25 = Trees 25+ cm dbh.

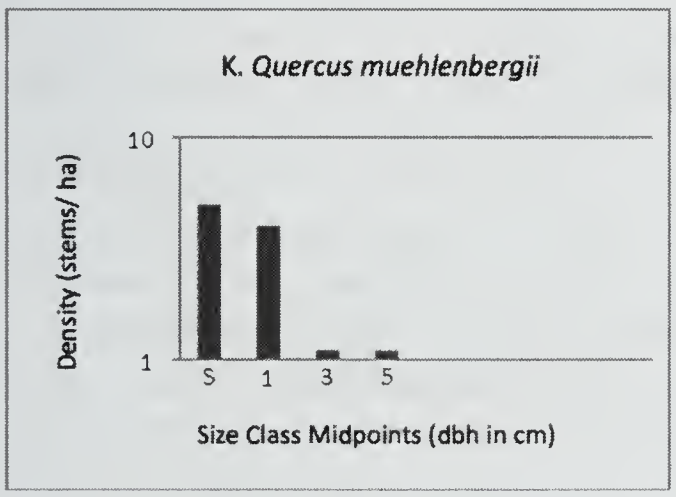
Tree density (341.58 trees · ha^{-1}) at THC was lower than that for Warren Dunes State Park (432.9 to 781.0 trees · ha^{-1}) reported by Smith and Woodland (2007). This is to be expected since Smith and Woodland (2007) included stems as small as 8 cm dbh, while I included stems no smaller than 10 cm dbh. When the density of 8–10 cm saplings (~ 120 · ha^{-1}r) from THC is added to the tree density, the total density (~461 trees · ha^{-1}) falls at the lower end of the











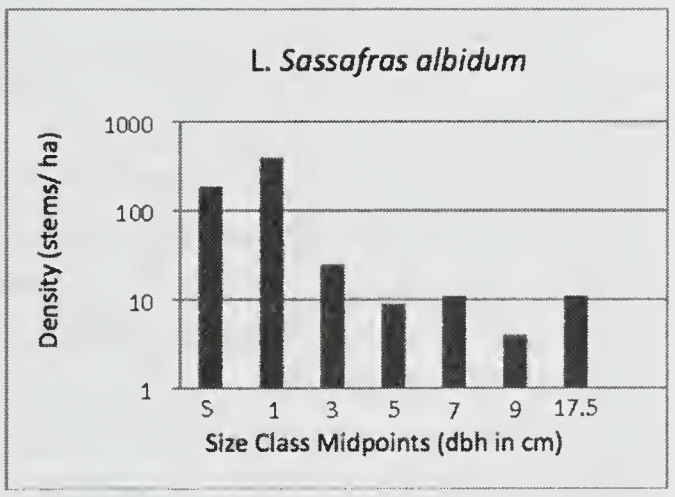


FIGURE 2. Continued.

range at Warren Dunes State Park. In addition, Smith and Woodland (2007) sampled an area that contained a greater range of tree ages, a greater diversity of species and a greater range of topographic conditions (e.g., elevational, slope and aspect differences), all of which may have influenced the density of trees.

Acer rubrum is a species indicative of wet areas (Barnes and Wagner 2004). At THC it reached its peak abundance in places where there was standing water

in Spring, 2009. Its shade tolerance (Barnes and Wagner 2004), its high fecundity (over 2000 seedlings · ha^{-1}) and size class structure (Figure 2A) support the hypothesis that this species will be a canopy dominant on mesic sites for some time into the future under the current climatic conditions; however, it is considered by some to be a sublclimax species, and would be replaced by other species should the area become more arid (Russell and Yawney 1990). Nevertheless, it is shade tolerant and an aggressive colonizer of disturbed sites (Russell and Yawney 1990) and may expand further into the upland sites after disturbances that create gaps in the forest.

The dominance of *Quercus rubra* seems to be a characteristic of forests adjacent to Lake Michigan that is not shared by forests more inland (Smith and Woodland 2007), such as the forest at Warren Woods State Park (Cain 1935; Gysel 1951; Woods 1979; Poulson and Platt 1996). Because the forest at THC is young, it is inhabited by early to middle stage successional species, *Quercus rubra* being one such species (Barnes and Wagner 2004). *Quercus rubra* is also well adapted to the mesic conditions present at THC. Its size class structure (Figure 2F), which shows a general decline in density from seedling to tree size classes, indicates its persistence as a canopy dominant. The high density of 7-cm dbh individuals preceded by the near absence of 9-cm dbh stems may have been due to an absence of a mast crop (acorns) in the several earlier years represented by the 9-cm dbh size class. This irregular production of a mast crop is a characteristic of *Quercus rubra* (Sander 1990) resulting from the natural selection for phenotypes that produce an unpredictable food supply for predators. It also may be due to some factor that increased mortality of the mast crop, seedlings or saplings during the years represented by the 9-cm dbh size class.

Fagus grandifolia existed at low frequency and had a distribution restricted primarily to the shallow slopes at the southwestern edge of the forest at THC. Because the larger of these trees were about 125 years old, they had been spared when the forest was last logged about 80 years ago. The size class distribution of *Fagus grandifolia* (Figure 2B) shows a species that is reproducing itself and may persist over time, however, it may not spread east into the adjacent lower and wetter area because its seeds germinate poorly on wet sites and because it is less tolerant of flooding than *Acer rubrum* (Tubbs and Houston 1990). It could, however, become a canopy dominant in the upland area to the north and east of its current location.

While *Acer saccharum* also existed at low frequency, it was scattered throughout the forest. While its size class distribution (Figure 2C) shows a decrease in density with increase in size, implying continued reproduction and future replacement, it will be a long time before it replaces the less shade tolerant species.

Pinus strobus had the highest Importance Value of all species on upland sites within the forest at THC (Table 2). While its seedling and sapling densities were lower than those for *Quercus rubra* and *Acer rubrum*, it is reproducing itself, but only in openings since its seedling survival is low in shade (Wendel and Smith 1990). Even though I intentionally excluded from my samples those *Pinus strobus* trees that were in obvious rows, some of the canopy pines

that I did sample may have been among those that were planted about 70–80 years ago in the northern portion of the study area, after that had been clear cut and/or burned.

Because *Prunus serotina* is a shade intolerant species (Marquis 1990), only those saplings found in a gap created by the demise of a canopy tree will be released from growth inhibition. In gaps, their rapid growth may get them to be canopy trees, maintaining this species at a low density.

Picea abies was undoubtedly introduced as a local planting on the eastern edge of the woods, the larger trees being those that were originally planted. Based on the age of three trees that were cored, these trees were planted about 80–90 years ago. The absence of stems in all but the smallest size classes (Figure 2J) may be due to an absence of reproduction as the planted trees matured to reproductive age. Another example of this pattern existed for *Liriodendron tulipifera* (Figure 2H) in which the three larger sapling classes (5 cm, 7 cm and 9 cm) are empty. Finally, the abundance of *Fraxinus pennsylvanica* seedlings and small saplings and the paucity of individuals in the tree size classes should be noted (Figure 2G). Few seed source *Fraxinus pennsylvanica* trees were found within the study area, so seeding most probably came from trees planted in the adjacent residential neighborhoods.

Present in the canopy were species of trees listed as shade intolerant to mid tolerant by Barnes and Wagner (2004). These include *Prunus serotina*, *Quercus rubra*, *Liriodendron tulipifera* and *Pinus strobus*. Their presence among the canopy species and their existence in the smaller size classes is most probably a feature of younger forests. As this forest matures, these species will likely be replaced by shade tolerant ones such as *Fagus grandifolia* and *Acer saccharum*. This forest then will be more like the climax forests that were here pre-settlement and more like the forest at Warren Woods State Park.

Quercus muhlenbergii and *Sassafras albidum* are two understory species whose size class structure (Figure 2K, L) shows the effects of canopy closure as the dominant tree species mature. *Quercus muhlenbergii*, which is shade intolerant (Barnes and Wagner 2004), may persist as saplings, but will never become important in the forest. That this species occurs within the woods at THC may be due to recent introductions. As for *Sassafras albidum*, its presence in the understory seems assured since it is shade tolerant as a seedling and smaller sapling (Barns and Wagner 2004). Its presence among the canopy trees will probably diminish as the canopy trees overtop the few of these taller sassafras individuals.

Judging from the size class structure of the trees in this forest which indicates that many of the tree species are reproducing themselves, this high quality (as determined from the FQI) stand appears to be in good health and will persist for some time into the future.

ACKNOWLDGEMENTS

I thank Robert Beemer of Deer Creek Open Spaces Association for making me aware of the need for this study, Greg Briggs, Interim Site Manager at Tower Hill Camp and Retreat Center, for per-

mission to use the woods at the camp as a place to do research and an anonymous reviewer for suggestions that made this paper more lucid.

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NOTEWORTHY COLLECTIONS

MICHIGAN

Aira caryophyllea L. (Poaceae). Silver hair grass.

Previous knowledge. Silver hair grass (*Aira caryophyllea* L.) is a small, tufted, erect, annual grass with narrow leaves and an open panicle of two-flowered, silvery-green spikelets with at least one lemma awned from a bifid apex (Figure 1) (Wipff 2007). It is native to Europe, western Asia and Africa and has been naturalized in North and South America and Australia (USDA ARS 2009). In North America, the species is known primarily from the Atlantic, Pacific and Gulf coasts, from Nova Scotia to Florida and Texas and from Alaska to California, with scattered inland populations (USDA NRCS 2009; Wipff 2007). This species has not been reported previously for Michigan (Voss 1972; USDA NCRS 2009). The nearest localities to Michigan for silver hair grass are in St. Joseph and LaPorte counties in northwestern Indiana (Swink and Wilhelm 1994).

Significance of the report. Recently, we collected *Aira caryophyllea* in Muskegon and Berrien counties in Michigan. The Berrien County site is approximately 20 miles north of the nearest Indiana site listed in Swink and Wilhelm (1994). The substrate at the LaPorte County, Indiana site is "sandy soil" (Swink and Wilhelm 1994). While the two Michigan locations are about 100 miles apart, both were in habitats similar to the LaPorte County, Indiana site, i.e., disturbed, open sites with sandy soil. Because disturbed sandy habitats are common in Michigan, we expect *A. caryophyllea* to be found in many locales within the state.

Specimen citations. The herbarium labels from the two collections are as follows:

> *Aira caryophyllea* L. MUSKEGON Co.: Camp Owasippe, ca. 5 mi NW of Twin Lake. Lat. & Long.: 43° 24′ 54″ N, 86° 13′ 24″ W. Along open margins of little used sand road through open *Quercus* forest. Abundant in a local area, all plants senescent, none still green, 18 AUG 2002, A.A. *Reznicek 11382. Nature Conservancy of Michigan "Bioblitz" team* (MICH, DOV, MSC, GH, DAO, ILLS, WIS, UWSP).
>
> *Aira caryophyllea* L. MICHIGAN, Berrien County (48638174N, 532601E) about 1 mi WNW of Sawyer. Numerous plants scattered in an area of ca. 3 m^2 near bottom of shallow (1–2%) N-facing slope in needle-strewn, sandy soil in partial shade of opening in *Acer rubrum*, *Pinus strobus*, *Quercus rubra* woods with *Festuca octoflora* and seedlings of *P. strobus*, *A. rubrum* and *Liriodendron tulipifera*. 6 August 2009. *Robert Tatina 4287* (MICH, DWU).

FIGURE 1. Aira *caryophyllea* (Photograph taken by Robert Tatina)

Diagnostic characters. Wipff (2007) has three subspecies of *A. caryophyllea*. Our specimens have acute glumes, pedicels which are less than 2 times the length of the spikelets, and spikelets which range from 2 to 3.5 mm long. This combination of character states fits *A. caryophyllea* L. var. *caryophyllea* and not *A. caryophyllea* var. *cupiana*, which has subobtuse glumes, or *A. caryophyllea* var. *capillaris*, which has longer pedicels and spikelets.

ACKNOWLEDGEMENTS

We thank Scott A. Namestnik, botanist at JF New, for his critical review of our manuscript which greatly improved it.

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——Robert Tatina
Biology Department
Dakota Wesleyan University
Mitchell, South Dakota 57301
rotatina@dwu.edu

Anton A. Reznicek
University of Michigan Herbarium
3600 Varsity Drive
Ann Arbor, MI 48108
reznicek@umich.edu

BOOK REVIEW

Paul E. Rothrock. 2009. **Sedges, of Indiana and the adjacent states: the non-Carex species.** (ISBN 978-1-88362-14-0. Indiana Academy of Science, Indianapolis, Indiana 46204. Available at http://www.indianaacademyofscience.org/publications/special/; $45.00. **Hard cover** (laminated w/o dust jacket), 6.25 × 9.25 inches, 1.9 lbs, 271 pages, 200+ color photos, 6 plates of fruit illustrations, keys, glossary, shaded county maps for Indiana and color designation maps for adjacent states, 3 appendices.

Here is a book that has to be in every Michigan botanist's library. Not only is Indiana adjacent to Michigan, but most Michigan species that do not occur in Indiana are also treated in the keys and discussed briefly. The Indiana Academy of Science website notes that they have 2620 copies available as of Nov. 4. This will be a best seller, so get yours now before they are all gone!

While this is basically a modern treatment of the 88 species of non-*Carex* sedges in Indiana, it is orchestrated in such a way as to be much more useful than a straightforward floristic treatment with keys, descriptions, and notes on habitats, associates, maps and remarks. So what are the elements that make this book especially useful? First off, the author clearly speaks from experience—no blind compilations from specimens and literature here. This is original work, the product of years of scholarship and becoming intimately familiar with the species by one of the premier sedge experts in the U. S. There are keys to all the species, but beyond the keys, there are helpful hints and ecological and life history discussions that are not only insightful and interesting, but often offer practical help with the most difficult plants. There are even frequently notes about interesting aspect of the species biology, ecology, and even history from elsewhere in the range of the plant as well. Also, every Indiana species (and a few additional species as well) is illustrated with excellent color photographs, some of which are habitat shots as well as plant portraits. Line drawings of achenes are illustrated for most Indiana species—including all for which achenes are diagnostic. A total of 232 figures are included, making this one of the most amply illustrated of modern sedge books. Every Indiana species is mapped by county within the state, and occurrence in adjacent states is also noted, so it is easy to get a clear idea of distribution. Finally, for some of the most difficult species complexes, such as the *Eleocharis palustris* complex, the *Scirpus atrovirens* complex, and the *Scirpus cyperinus* complex, there is a detailed table comparing species for a range of features. Throughout the book, there is also a careful focus on distinguishing difficult and easily confused species pairs or triplets such as *Eleocharis engelmannii*, *E. obtusa*, and *E. ovata*, *Schoenoplectus purshianus* and *S. smithii*, and *Scleria reticularis* and *S. muehlenbergii*, among others. For the *Eleocharis* trio, photographs of the achenes of the three side by side are worth pages of careful measurements and descriptions.

There are a lot of additional facts available in the book in tabular materials in

Appendices. There is a checklist of all non-*Carex* Sedges of Indiana that includes their life cycle, whether annual, perennial, or both, and also the wetness ranking and coefficients of conservatism (a measure of the fidelity of the species to native communities, not political affiliation). There is an appendix that lists old synonyms, so that you can easily annotate your older floras and notebooks with the modern names. An interesting appendix is a key to "Indiana's dozen most frequently encountered Sedges (excluding the genus *Carex*)" which allows identification, with minimal dissection and measurements, of most species a beginner would encounter.

There is also a glossary of botanical terms that will help with definitions used in keys and descriptions (though some undefined modern phylogenetic terminology like clade and cladistic, homoplasy, monophyletic, etc. may still raise eyebrows among some).

Finally, I want to note that there are interesting tidbits of fact and observation scattered throughout. The writing has not been squeezed dry to make it as dull and uninteresting as possible, as so often seems the case with scientific literature. This makes the book not only useful to professional botanists, but interesting to naturalists and amateurs wanting to know more about one of the most important groups of plants ecologically in our flora. There are even English names listed for every species for people with a phobia of Latin—my favorites are hair sedge for *Bulbostylis capillaris*, wicket spike rush for *Eleocharis rostellata*, and whip grass for *Scleria triglomerata*.

Whatever your interests and needs: field identification, work in the Herbarium, restoration and wetland mitigation, and even gardening, this book will be a helpful tool.

A.A. Reznicek
University of Michigan Herbarium
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8. Italicize all scientific names. Voucher specimens must be cited for floristic works or any other relevant study. Papers citing plant records without documenting vouchers are generally not acceptable.

9. Manuscripts may be submitted electronically to the email address of the editor. Printed versions of manuscripts may also be submitted in which case three copies should be provided. All manuscripts will be reviewed by at least two referees. A more complete set of instructions is available at http://www.michbot.org/publications/Botanist/instruct_authors.htm.

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On the cover: A new species of goldenrod, *Solidago vossii* (Voss's goldenrod), named in honor of Edward G. Voss. Photographed by P. J. Laureto 8 August 2001 (see page 105 for related text).